DICTIONARY OF MEDICINE

R. QUAIN, M.D.

22101787474

Digitized by the Internet Archive
in 2014

https://archive.org/details/b20415539_002

2312

A

DICTIONARY OF MEDICINE

INCLUDING GENERAL PATHOLOGY, GENERAL THERAPEUTICS
HYGIENE AND THE DISEASES OF WOMEN AND CHILDREN

BY VARIOUS WRITERS

EDITED BY

RICHARD QUAIN, BART., M.D.LOND., LL.D.ED., F.R.S.

President of the General Council of Medical Education: Member of the Senate of the University of London
Hon. M.D. Trin. Coll. Dublin: Hon. M.D. Royal University of Ireland
Fellow, late Vice-President and Senior Censor of the Royal College of Physicians
Hon. Fellow of the Royal College of Physicians of Ireland

Physician Extraordinary to Her Majesty the Queen

Consulting Physician to the Hospital for Diseases of the Chest, Brompton
and to the Seamen's Hospital, Greenwich

ASSISTED BY

FREDERICK THOMAS ROBERTS, M.D.LOND., B.SC.

Fellow of the Royal College of Physicians: Fellow of University College
Professor of Materia Medica and Therapeutics, University College
Physician and Professor of Clinical Medicine, University College Hospital
Consulting Physician to the Hospital for Consumption and Diseases of the Chest, Brompton

AND

J. MITCHELL BRUCE, M.A.ABDN., M.D.LOND.

Fellow of the Royal College of Physicians
Physician and Lecturer on the Principles and Practice of Medicine, Charing Cross Hospital
Physician to the Hospital for Consumption and Diseases of the Chest, Brompton

NEW EDITION, REVISED THROUGHOUT AND ENLARGED.

DIVISION II.

LONDON
LONGMANS, GREEN, AND CO.
1894

All rights reserved

M16837

WELLCOME INSTITUTE
LIBRARY

Coll.	welMOmec
Call No.	WB 100 1894 Q1A

any preliminary training, and thus throw such an unexpected strain on the heart and great blood-vessels, that instead of mere functional disturbance, as in early life, they sow the seeds of organic disease. Such being the case, how much more injurious must sudden overstrain be to a heart already weakened by disease? There is often found amongst men a great aversion to having their hearts examined, and when disease is discovered it is sometimes considered of questionable advantage to inform the sufferer of his condition; but this is a mistake, for from want of knowledge of his state he may, by unnecessary strain, rapidly aggravate it, and thus shorten a life which might otherwise have been much prolonged.

The purport of these observations is thus to point out that: First, whereas exercise is necessary to preserve our bodies in a proper state of healthy activity, its tendency, when carried to extremes, is to set up organic lesions. Secondly, that as in some athletic competitions a very great strain is thrown upon the thoracic organs, it is essential that no boys of delicate frame should be allowed to take part in them, or in the preliminary training, excepting under careful medical supervision. And, thirdly, that in manhood no violent competition should be undertaken, which would throw a great strain upon the thoracic organs, without their being previously examined and pronounced sound, nor until their full powers have been brought into play by careful preliminary training.

A. B. R. Myers.

EXFOLIATION (*ex*, from; and *folium*, a leaf).—The separation of a portion of dead bone or cartilage from the living tissue, in the form of layers (*see* Bone, Diseases of). The term is also applied to the separation of a false membrane, which has been mistaken for the whole mucous lining of the bladder or uterus. *See* Bladder, Diseases of.

EXHAUSTION (*ex*, from; and *haurio*, I draw out).

Definition.—Exhaustion is a phenomenon which all irritable tissues can be made to manifest, and consists in a failure to respond to stimulation. Exhaustion of muscle and nerve is brought about by excessive, quickly repeated, or continuous stimulation. It is favoured by cutting off, or by an alteration in the quality of, the blood-supply; by previous insufficient exercise of function; by exposure to extremes of temperature; by an insufficient supply of oxygen; by an excessive supply of carbonic acid; and by exposure to certain toxic agents. These facts, which have been established by physiological experiments, are fully borne out by clinical experience.

Exhaustion may be *general* or *local*.

1. **General Exhaustion.**—General exhaustion is brought about by over-work, whether physical or mental, and especially by unremitting and monotonous duties which keep the same paths of action in a state of constant activity. It is not often, if ever, that any permanent harm is produced in a healthy man by mere physical labour, however great; but excessive mental labour, especially if it be monotonous, is certainly capable of permanently damaging the nervous tissues. When in addition to hard mental work, which is performed voluntarily, some constant stimulus, which cannot be arrested, unceasingly works upon the brain, exhaustion quickly results; as when, for example, a man who is harassed by trying to earn sufficient for his family meets with some shock to his nervous system (such as a railway accident, the sudden death of a dear relative, or a severe money loss) which haunts him like a spectre day and night, robs him of his rest, and deprives him of his appetite. General exhaustion is favoured by all conditions which give rise to anæmia or faulty nutrition, such as hæmorrhage, prolonged pyrexia, inadequate diet, persistent morbid discharges, or venereal excess; by the retention in the tissues of the products of their activity, which is favoured by working in a foul atmosphere, or by derangement of the excreting functions; by exposure to extremes of temperature; and by a previous condition of excessive slothfulness. General exhaustion may occasionally be suddenly induced by physical causes, such as a severe injury (collapse from shock), or psychical causes, such as fright.

Symptoms.—The symptoms of general exhaustion are: 1. Loss of sleeping power, persistent dreaming, talking in the sleep, and somnambulism. The patient may wake in the morning feeling totally unrefreshed. 2. Incapacity for work, and inability to seriously apply the mind to one subject for any length of time. 3. Headache, and a feeling of oppression in the head. 4. Languor and general lassitude. 5. A rapid feeble pulse. 6. An anxious expression of face; and (as stated by Dr. George Johnson) a contracted and sluggish pupil. In addition to these we may get tremor, delirium, hypochondriasis, hysteria, epilepsy, chorea, mania, and general paralysis. Two instances have come within the writer's knowledge of transient hemiplegic symptoms having been induced by excessive application to literary work. The digestion is often deranged, and functional disturbance of the heart is common. Occasionally the urine is altered in quality, and may contain alkaline phosphates or sugar. More rarely it manifests excessive acidity.

2. **Local Exhaustion.**—Local exhaustion is the result of excessive local stimulation, and it is particularly liable to occur as a prominent symptom in patients who are suffering from general exhaustion. The loss

of power in the rectum which results from the excessive use of purgatives; the failure of the uterus in cases of protracted labour; and the failure of the voluntary muscles which occurs in those professional ailments of which 'writer's cramp' is the type, may be taken as examples of local exhaustion.

Treatment.—In the treatment of exhaustion the main indications are to lighten the labour, and obtain rest. In cases of general exhaustion it is often advisable to administer narcotics, such as opium, chloral, sulphonal, or bromide of potassium; and it will be generally found that, when once refreshing sleep has been established, the more aggravated symptoms will subside. Fresh air and a good diet are most necessary. Stimulants must be used with great caution, for it is clearly not desirable to goad the exhausted organs into further action, although it may be necessary to employ stimulants to give temporary power while the faculty of sleeping is being re-established. All causes of anæmia must be removed. When recovery is established, the patient must be encouraged to relieve the monotony of his life by some pursuit which should be, as it were, the complement of his ordinary occupation. Thus the head-worker should endeavour to amuse himself in his leisure hours by gentle out-door exercise, by music or painting, or by practising some handicraft. *See* Debility; and Fatigue.

G. V. Poore.

EXOMPHALOS (ἐξ, out; and ὀμφαλός, the navel).—A term applied to umbilical hernia. *See* Hernia.

EXOPHTHALMIC GOÎTRE (ἐξ, out; ὀφθαλμός, the eye; and *guttur*, the throat).—Synon.: Graves's Disease: Basedow's Disease; Fr. *Maladie de Graves*; *Goître exophthalmique*; Ger. *Glotzaugenkropf*; *Basedow'sche Krankheit.*

Definition.—Enlargement with vascular turgescence of the thyroid gland, accompanied by protrusion of the eyeballs, breathlessness, palpitation, tachycardia, and anæmia.

Ætiology.—This disease is comparatively rare in men. It occurs most frequently in women between the ages of twenty and thirty, but is met with amongst older persons. Patients suffering from it often belong to the so-called nervous diathesis. Its occurrence is often preceded by menstrual disturbance and anæmia. Sometimes no exciting cause can be discovered, but in many cases it comes on after violent nervous excitement, sometimes after acute disease.

Symptoms.—Before exophthalmic goître makes its appearance, alterations in temper are frequently observed, the patient becoming irritable and depressed. Functional disturbances of the circulation and heart occur at frequent intervals, the heart palpitating, the face flushing, and a sensation of fulness being felt in the head, eyes, and throat. The palpitation increases, the eyes become prominent, and a visible swelling appears in connexion with the thyroid gland. The eyes are lustrous and projecting, and there is frequently a slight loss of co-ordination between their movements and those of the eyelids, so that when the eyes are quickly cast down the eyelids follow them so slowly that a white ring of sclerotic may be noticed between the iris and the lower margin of the upper eyelid. Usually there is no disturbance of vision. The exophthalmos is most marked during emotional excitement and at the menstrual period, and at these times the patient suffers from an increased feeling of fulness in the eyeballs. Sometimes the projection of the eyeballs is so great that the lids do not perfectly cover them, and inflammation and ulceration may consequently occur. The thyroid is generally unequally enlarged. Its size varies from time to time, increasing, like the protrusion of the eyeballs, with emotion. It is soft and elastic, and pulsates, so that it has sometimes been mistaken for aneurysm. The palpitation of the heart is generally noticed before either the exophthalmos or enlargement of the thyroid, and is the first symptom to attract the patient's attention. It is increased by emotion or exertion; and the violent cardiac action frequently produces a prominence of the præcordial region. The cardiac pulsations are rapid, and sometimes irregular. The cardiac sounds are loud; and a soft, systolic bellows-murmur is frequently audible at the base, and in the large arteries. The carotids are sometimes, but not always, dilated. The circulation appears to be rapid, the veins filling quickly when emptied, and pulsation being felt even in small arteries. The temperature is frequently high. There is a feeling of general debility. The digestion is sometimes normal, at other times the appetite is diminished or capricious, and diarrhœa may occur. The swelling of the neck may give rise to a feeling of difficulty of breathing; and the voice sometimes becomes altered and hoarse, or may be lost entirely. The course of the disease varies considerably: it may sometimes go on increasing for several months, then it becomes stationary for one or two years, and afterwards begins to decline. The temper improves, the appetite increases, and menstruation frequently is re-established. The palpitation, enlargement of the thyroid, and prominence of the eyes gradually diminish, although they rarely disappear completely. Death may occur from intercurrent disease, from organic cardiac lesions, from uncontrollable diarrhœa, or from gradual wasting. Danger is also said to arise from pressure on the trachea by the enlarged thyroid.

Pathology.—The protrusion of the eyeballs is due either to dilatation of the vessels in the orbit, or to contraction of the involuntary muscular fibres in the orbital membrane which covers the spheno-maxillary fissure, or possibly to both causes combined. The enlargement of the thyroid is due to dilatation of the vessels of the gland. After the disease has lasted some time, increased formation of tissue in the thyroid gland may occur. Palpitation of the heart is probably due to stimulation of the accelerating cardiac nerves; and this, as well as the alteration in the nerves of the orbit and thyroid, has been ascribed to disease of the lower cervical sympathetic ganglia, in which increased connective tissue and diminution of ganglionic cells have been observed.

Diagnosis.—When the three leading symptoms are present, it is impossible to confound exophthalmic goître with any other disease. The enlargement of the thyroid is distinguished in this disease from that of cystic goître by its greater elasticity, by its paroxysmal enlargement, and by its pulsation. The exophthalmos is distinguished from that due to disease of the orbit or cranium by being equal in both eyes, and by the absence of squint. It is distinguished from prominence due to cardiac disease by the lustrous appearance of the eye; from hydrophthalmia by the natural condition of the pupil; and from the prominence which may occur in myopia by the vision being natural, and by the paroxysmal increase of the prominence in exophthalmic goître.

Prognosis.—This must be guarded, the disease not being very amenable to treatment, and very rarely disappearing altogether, although after continuing for some years it may gradually improve.

Treatment.—The treatment of exophthalmic goître chiefly consists in securing fresh air, gentle exercise, the avoidance of the least fatigue or emotional disturbance, and careful diet. Iron is sometimes useful, the milder forms, such as the tartarated iron or citrate of iron and ammonia, being preferable to the more powerful preparations. The writer believes he has seen much improvement from saccharated solution of lime. Quinine, alone or in combination with digitalis—and perhaps with belladonna—often produces good results. Digitalis and strophanthus are occasionally, but not always, useful. Aloes and myrrh may be employed to keep the bowels open. Galvanism to the neck has sometimes been productive of benefit, one pole being placed on the nape of the neck and the other along the sides of the thyroid tumour. When the eyeballs are so prominent as to become liable to inflammation and ulceration, care must be taken, by means of a shade, to protect them from irritation; and if this should prove unavailing, the inflammation must be treated by appropriate remedies.

T. Lauder Brunton.

EXOSTOSIS (ἐξ, out of; and ὀστέον, a bone).—A bony outgrowth from any part of the skeleton. *See* Bone, Diseases of.

EXPECTANT ATTENTION.—An important mental state. *See* Mesmerism.

EXPECTORANTS (*ex*, out of; and *pectus*, the chest).—Synon.: Fr. *Expectorants*; Ger. *Auswurfsbefördernde Mittel.*

Definition.—Medicines which facilitate the removal of secretions from the air-passages.

Enumeration.—The leading expectorants are:—(A) Ipecacuanha, Antimony, Apomorphine, and Iodide of Potassium; Chlorides of Potassium, Sodium, and Ammonium; and Inhalation of Steam. (B) Squill, Senega, Benzoin, Benzoic Acid, Benzoate of Ammonium; Myrrh, Storax, Balsam of Tolu, Balsam of Peru, Ammoniacum, Galbanum, Asafœtida, Anise, Fennel; Larch Bark, Tar, Terebene, Copaiba; Vapour of Chlorine, Iodine, Ammonia, Creasote, and Carbolic Acid. (C) Ammonia, Carbonate of Ammonium, Strychnine, Nux Vomica, and Belladonna.

Action.—The mode of action of expectorants is not well understood, and any explanation of it in the present state of our knowledge can only be regarded as provisional. Expectorants may be divided into two classes—(1) Those which modify the nature of the secretions from the respiratory passages; and (2) those which modify the respiratory movements by which the secretions are expelled. In considering the mode of action of the first class it must be remembered that the secretions from the respiratory passages depend, like many other secretions, on two factors, the *direct* influence of the *nerves* upon the secreting structures, and the *amount of blood* supplied to them. Each of these two factors may be influenced to a different extent by various drugs. As has already been said, the exact action of each cannot be determined at present, but the first class of expectorants may be subdivided into two divisions which are distinguished in the foregoing enumeration as A and B. The division A rather diminish than increase the activity of the circulation, and are therefore called *sedative* expectorants. The division B somewhat increase the circulation, and are called *stimulating* expectorants. Those comprised under C *stimulate the respiratory centre* in the medulla oblongata, and increase the respiratory movements.

Uses.—*Sedative expectorants* (class A) are useful when there is congestion of the respiratory passages, with very scanty, tough expectoration, as in commencing bronchitis. In such circumstances, when dry rhonchi are heard abundantly, with few or no moist râles, the patient often coughs until quite exhausted, bringing up scarcely anything. The administration of sedative expectorants renders the secretion from the respiratory passages more fluid, abundant, and easy to expectorate. When these expectorants do not succeed in ordinary doses, their action may be much assisted by the administration of a purgative, or, still better, by giving either ipecacuanha or tartar emetic in such a large dose as to produce sickness and vomiting. When the distress of the patient is great, the abstraction of a small quantity of blood by cupping or by venesection may give great relief. The inhalation of steam alone is also beneficial, and the air of the patient's chamber should be kept warm and moist.

Stimulating expectorants (class B) do more harm than good when administered in the conditions just described, but are beneficial when the acute symptoms have passed off. When this is the case, but the expectoration is tough and somewhat scanty, squill is a useful expectorant; but when the expectoration is abundant, benzoin, balsams or ammoniacum would be preferable. In chronic bronchitis, inhalations of ammonia, chlorine, iodine, creasote, carbolic acid, eucalyptus, or pine oil are useful. When the expectoration is fœtid, chlorine, iodine, and carbolic acid inhalations are best.

The expectorants which act on the respiratory movements (class C) are useful in cases of debility, as they stimulate the respiratory nervous centre in the medulla oblongata, as well as assist the failing circulation. They may be advantageously combined with stimulating expectorants, such as squill or benzoin, according to the nature of the secretion.

T. Lauder Brunton.

EXPECTORATION (*ex*, out of; and *pectus*, the chest).

Definition.— This word, which strictly means the act of expelling anything from the chest, is usually applied to the matter so expelled, which is also called *sputum* or *phlegm.*

The Act of Expectoration.—The smaller bronchial tubes are kept free from obstruction by the action of ciliated epithelium. The area of the smaller tubes being greater than that of their trunks, the air passes more forcibly through the latter, and so tends, even in natural breathing, to carry speedily away any accumulated secretion. The forcible acts of coughing (*see* Cough) and 'hawking' increase the natural force and fulness of the expiratory effort, and clear the air-passages; the repeated closure of the glottis in coughing increases still further the expulsive effect, by causing the air to escape in sudden jerks. If the glottis cannot close in consequence of laryngeal disease, the act of expectoration becomes painful and difficult. Efforts at expectoration are also laboured and futile if the power to take a deep inspiration is lost in consequence of emphysema or muscular weakness.

Inability to expectorate is often the immediate cause of death, the 'suffocative catarrh' of the dying being another name for accumulation of phlegm which the patient is powerless to remove. By teaching the patient 'how to expectorate,' by the administration of a timely stimulant or a quickly acting emetic, or by change of posture, life may in such a case be prolonged. Should the sufferer be allowed to get flurried, the breathing becomes more and more shallow, and deep inspiration and free expectoration are impossible. If, however, the patient can be induced to breathe calmly and deeply, to assume a more easy posture, and to swallow a mixture of ammonia with ether, the breathing gradually becomes less shallow and rapid, air enters the deeper parts of the lung, and power is gained to evacuate the accumulated secretion (*see* Stertor). The act of expectoration is, as a rule, most easy in that posture in which respiration is most free. Sometimes when the secretion comes mainly from one lung, the aid of gravitation may be called in to empty the obstructed tubes.

Characters and Varieties.—Before auscultation was practised, diagnosis was often based on the character of the expectoration, unwarrantable importance having been attached to the distinction between pus and mucus, on the assumption that pus was diagnostic of phthisis. At the present time we are apt to lose much useful information by falling into the opposite error.

In health, the secretion from the mucous membrane of the air-tubes is a transparent, colourless, slightly glutinous liquid, like thin mucilage; it contains mucin, a varying quantity of saline matter, and water.

The saline matter is abundant in the transparent viscid expectoration, deficient in the opaque and less tenacious kind, least in that which is actually purulent.

The ordinary mucous secretion is increased in quantity and viscidity as a result of simple catarrhal inflammation of the bronchial membrane. When bronchitis has existed for some days, a change occurs in the character of the secretion; instead of being transparent and viscid, it becomes semi-transparent and then opaque, the colour changing to a yellow or greenish hue.

The sputum becomes frothy from the admixture of air; and rusty or prune-juice-coloured if the inflammatory action extends to the ultimate bronchial ramifications, and is of so intense a kind as to allow of oozing from the capillary vessels.

Fibrinous moulds of the bronchial tubes, or chalky masses consisting of inspissated and calcified cheesy matter, are not infrequently expectorated.

The dark grey or blackish stain often seen in expectoration may be derived from carbon in the atmosphere; or, if it fade on the addition of nitric acid, it may be due to pulmonary pigment formed under slight irritation.

The expectoration may afford important aid in diagnosis, as may be illustrated by the following examples: If a person with severe chest-complaint coughs frequently and spits only frothy salivary fluid, we may suspect pleurisy. If the fluid is glairy, like white of egg, we may suspect bronchitis. If it has a rusty tinge and resembles thick gum-water coloured with blood, we are not likely to err in recording pneumonia. If there is a sudden gush of fœtid pus we may diagnose abscess in the lung or an empyema.

Purulent expectoration may occur in bronchitis as well as in phthisis; but if long continued, and unaccompanied by distinct rhonchus, it almost always comes from a vomica. The excessively offensive expectoration of pulmonary gangrene, and that arising from a bronchiectatic saccule, are diagnostic of the affections from which they spring.

In phthisis the sputum is at first salivary or frothy, the result of irritation; then viscous, indicative of more confirmed affection of the mucous membrane; and subsequently dotted and streaked with blood. Whitish opaque spots, giving a pearly aspect to the expectoration, next appear; these enlarge, become flocculent and ultimately nummular, being inspissated and moulded in a cavity. As the disease advances and involves both lungs, the expectoration is entirely purulent, and shortly before death is often surrounded with a pinkish halo. On placing under the microscope one of the small pearly points described, masses consisting of several air-cells choked with granules, or mere fragments of elastic tissue may occasionally be seen. By the addition of acetic acid the sputa may be rendered transparent, and the elastic tissue is then, if present, more certainly detected; but practically the experienced eye is the best guide in the selection of those small pin-head flocculi of expectoration, in which the microscopic particles of lung-tissue are to be detected.

The microscope may also be helpful by indicating, from the character of the cells, the part of the respiratory tract involved, and the degree of disease existing. (For the detection of tubercle bacilli, a point of great practical importance, *see* PHTHISIS; and SPUTUM, Examination of.) The existence of cancer of the lung may sometimes be detected by a microscopical examination of the expectoration.

TREATMENT.—In treatment, much may be gained by study of the expectoration. The cough may often be relieved, and the dyspnœa and other symptoms removed, by effecting an alteration in the nature of the secretion.

If by the frothy character of the sputa congestive disorder is indicated, this may be met by the application of warm poultices, turpentine stupes, or hot flannels externally; and by such means as are calculated to reduce fever and irritability, namely, the administration of salines with antimony or aconite. If the expectoration is too viscid and glutinous for easy removal, lemon-juice, liquor potassæ, soda, or various inhalations give relief, by lessening the tenacity of the secretion; or the change from tenacious and transparent to opaque, less adhesive secretion may be hastened by giving iodide of potassium with a few drops of antimonial wine.

When muco-purulent secretion is established and shows no sign of diminution, the use of senega and of the gum-resins is indicated; these may be given in the form of lozenge, while benzoin, tolu, and copaiba are also of value. Acetic or tannic acid, given in small and frequently repeated doses, reduces the quantity of secretion.

When the combined glairy and muco-purulent condition of the expectoration and other symptoms give evidence of bronchitis of an established kind, associated with gout or abdominal torpor, a combination of calomel with antimony and guaiacum (as in Plummer's pill) is of the greatest service; but this treatment needs perseverance, discrimination, and watchfulness. The morbid surface may at the same time be medicated by the inhalation of tar, creasote, or oil of juniper, until, with the improvement of the general health, under cod-liver oil and iron, the evil is entirely removed.

E. SYMES THOMPSON.

EXPOSURE, Effects of.—Were the term 'exposure' to be taken in its widest significance, it might fairly claim to include a range of subjects only bounded by the limits of practical medicine. Infection naturally implies exposure to some contagious influence, poisonous gas, or malarious or other unhealthy emanation, bearing in its train a formidable sequence of ill results, and probably depending on the introduction within the system of a specific form of microbe. Many of the disorders which impair our comfort and shorten our lives may, indeed, be traced, in some degree, to exposure of some kind, to an excess of heat or of cold, to a variety of complicated reactions, arising, in whole or in part, from unnatural impressions made on the physiological processes of life by various external agencies. Any study of our subject, however, from this extended point of view, would clearly be out of place here, and effects of extreme elevation and depression of temperature will be fully considered elsewhere; so that exposure, in the sense in which it will be treated here, may be narrowed down to the results which ensue when persons of average constitutional power are submitted, for a longer or shorter time, to the influence of ordinary cold, or wet, or damp. Now, it is an old saying, that if five or six people, of either sex, suffer shipwreck, or are wet through, or excessively chilled by moist cold, each will probably suffer in some different way. One may altogether escape, and not experience inconvenience of any kind; a second may 'catch'—as the popular expression puts it—a sore-throat, or a 'bad cold;' whilst a third may be seized with pneumonia; and a fourth with rheumatic fever.

Individual constitution or idiosyncrasy partly explains these differences, and the familiar term of a 'weak point somewhere,' if not conveying much impression of scientific accuracy, is right so far in showing that the internal congestion caused by sudden contraction of cutaneous arterioles is most naturally directed to that organ whose vessels have been weakened by previous inflammation. If the patient, therefore, have previously suffered from tonsillitis, or bronchial congestion, or rheumatism, he will be predisposed to a recurrence of the same affection on a renewal of the exciting cause. If, again, from sedentary occupation and over-indulgence in nitrogenous food, his blood be overcharged with the products of retrograde metamorphosis or of imperfect assimilation, it only needs the closure of the eliminatory agency of the skin, to provoke the irritation of internal organs, and to induce an attack of gout or rheumatism, or an acute inflammation of kidneys or liver. The effects of exposure, even in this limited sense, are thus tolerably various both in extent and in degree, and may be studied on a large scale during our greater campaigns, and in lesser degree during the ordinary autumn manœuvres, when the weather happens to be unfavourable. Here, however, everything injurious is minimised by the healthy condition of the men, their good clothing and food, and the enforced regularity of habits, which prevent, in great measure, one of the most fertile causes of damage from exposure; and among the most efficient means for preventing the potent influence of bacilli for evil, we must place all hygienic means which improve the bodily vigour. It is now well known that nothing tends so seriously to impair the power of bearing either extreme of temperature as excessive indulgence in strong drink; so that in treating anyone who has been exposed to the influence of cold and wet, we must not forget to take also into account the probable combination of the depressing effects of alcohol on the nervous system. Illustrations of this must be familiar to all, and we must all have met with numerous cases in which tramps or other persons with weakened bodily vigour have been brought into our hospitals, suffering from the effects of exposure in various degree.

Treatment.—In seeking to remedy the effects just described, it will be found that some of the cases will recover under the influence of warmth and good food, and the generally invigorating effects of careful nursing; whilst others, on the other hand, may succumb to the rapidly destructive tendencies of acute disease, or to the slower pathological processes of chronic lung or kidney degeneration. In the treatment, therefore, of such cases, we must not only add to the genial influences of home or hospital care such special drugs as the varied development of symptoms may require, but we must carefully take into account the occurrence of various serious or profoundly disorganising complicating causes. Thus if our patient has been found in an insensible state, we may reasonably suspect cerebral hæmorrhage or alcoholic or narcotic poisoning, and act accordingly. And only when all such suspicion is finally removed can we rest on our oars, and confine our attention to the immediate effects which follow exposure of the kind indicated above. Warmth, rest, and the regulated use of stimulants and food will now be indicated, and must be employed, with all the precautions suggested by the ordinary principles of therapeutics and by common sense.

Robert Farquharson.

EXSANGUINE (*ex*, without; and *sanguis*, blood).—Deprived more or less of blood—bloodless. Sometimes used synonymously with anæmic. *See* Anæmia.

EXTRA-UTERINE FŒTATION. *See* Pregnancy, Diseases and Disorders of.

EXTRAVASATION (*extra*, without; and *vasa*, vessels).—Synon.: Fr. *Extravasation*; Ger. *Extravasat.*

Definition.—Extravasation is the escape of any of the fluids of the body, normal or abnormal, from the vessel, cavity, or canal that naturally contains it, and its diffusion into the surrounding tissues. The result of the effusion is also called *an extravasation.*

Extravasation, being the effect of rupture or perforation of the walls of a hollow organ, may be due to injury, to weakness of the parietal structures, to morbid conditions of the blood, or to increase of internal pressure. *See* Perforations and Ruptures.

The fluids most frequently found extravasated are blood, urine, bile, the contents of the alimentary canal, and certain constituents of morbid growths and fluid collections. The present observations will have reference only to extravasation of blood; other kinds of extravasation being described under the heads of the several organs involved.

Extravasation of Blood.—The blood is peculiarly liable to extravasation, the vessels being universally distributed, much exposed to injury—a very common cause of this lesion—and subject also to a constant pressure from within, which may be suddenly and greatly increased. Any portion of the circulatory system may give way: the heart, as in fatty degeneration; the arteries, as in aneurysm; the capillaries, as in pulmonary hæmorrhage; the veins, as in the subcutaneous rupture of a varix.

When the effusion takes place into one of the serous sacs, it forms a collection of blood, variously named *hæmothorax*, *hæmatocele*, &c. If the subcutaneous, submucous, or other connective tissue, or the substance of an organ, be invaded, the effused blood finds its way between the elementary textures, separating and compressing them; and there are formed what are described simply as *extravasations* of blood, or more definitely, according to their extent, *parenchymatous* or *interstitial hæmorrhages* or *apoplexies*, *suffusions*, *ecchymoses*, *petechiæ*, or *vibices*. The extravasated blood generally coagulates; the fibrin and albuminous substances are absorbed; and the products of the decomposition of hæmoglobin, which are much more slowly removed, give rise to the familiar discolorations. The seat of effusion first appears of the colour of blood or its derivatives; but if much below the surface, the extravasation may not be visible for some days, after which time it appears of a bluish, greenish, or yellowish hue. Much less frequently the effused blood becomes encapsuled, forming a *hæmatoma* or *blood-cyst*, such as is occasionally seen in connexion with the chest or abdomen. In other cases it decomposes, and sets up gangrene around, or inflammation of the nature of severe cellulitis, which may end in ulceration. When the blood is forced between the coats of the perforated vessel, there is formed what is called a *dissecting aneurysm*. If the extravasated blood escape from the surface of the skin or mucous membranes, one form of *hæmorrhage* or a *bloody flux* is the result.

The *symptoms* of extravasation of blood are so various that they cannot be stated in general terms. If extensive and affecting vital parts, the effusion may be attended with shock, syncope, or death; and it may lead to constitutional disturbance in many forms. Local pain is not common unless the extravasation be severe. The pressure of the effused blood upon the vessels, nerves, and muscles of the part—in a limb, for example—may produce paralysis, disturbances of sensibility, œdema, loss of temperature, and even gangrene. As a rule, however, extravasations of blood are limited in size, give rise of themselves to no serious symptoms, and readily disappear by absorption.

J. MITCHELL BRUCE.

EXTROVERSION (*extra*, outwards; and *verto*, I turn).—The eversion or turning inside out of a part, as the eyelids or bladder. In the bladder, extroversion is associated with that condition, usually congenital, in which the anterior wall of this organ and of the abdomen is deficient, and its posterior wall projects through the opening thus formed.

EXUDATION (*exudo*, I sweat).—The process by which certain of the elements of the blood pass through the walls of the blood-vessels into the surrounding tissues, as in inflammation. The term is also used to indicate the products of this process, when they are of a fibrinous or coagulable character. *See* INFLAMMATION.

EXUDATION - CORPUSCLES. — The cells found in inflammatory products, whatever their origin may be. *See* INFLAMMATION.

EYE, and its Appendages, Diseases of.—SYNON.: Fr. *Maladies des Yeux*; Ger. *Augenkrankheiten*.

It will be most convenient to arrange the consideration of the diseases of the eye according to the anatomical order of the structures affected, namely: I. Diseases of the Conjunctiva; II. Diseases of the Cornea; III. Diseases of the Sclerotic; IV. Diseases of the Iris; V. Diseases of the Crystalline Lens; VI. Glaucoma; VII. Diseases of the Optic Nerve and Retina; VIII. Diseases of the Choroid; IX. Diseases of the Vitreous Body; and, X. Diseases of the Eyelids.[1]

I. Diseases of the Conjunctiva.

1. *Inflammation.*—SYNON.: Conjunctivitis. The conjunctiva is exceedingly liable to inflammation, and its inflammations are commonly arranged in groups, which are sufficiently distinct in their typical examples, but are not separated by any definite boundary lines.

In their earlier stages inflammations of the conjunctiva possess many characters in common. They are all attended by the four signs of inflammation—heat, redness, swelling, and pain; although both the heat and the swelling are usually kept within limits by the discharge, which is often free, sometimes profuse, at first mucous, afterwards muco-purulent or truly purulent in character. If, however, the exudation be of a firmer consistence than usual, it not only produces a superficial discharge, but distends the meshes of the sub-mucous tissue, elevates the conjunctiva from the sclerotic, and causes it to overlap the corneal margin as a swollen ridge; a condition which is known as *chemosis*. The redness depends, of course, on the degree of the congestion, which may or may not be sufficient to obliterate the intervascular meshes, and to produce a uniform colour; and the pain is not severe, except in cases of very dense sub-conjunctival swelling. From other forms of inflammation, that of the conjunctiva is distinguished by certain negative characters. Unless as a result of secondary changes, or as a mechanical effect of the presence of a film of turbid secretion, the transparency of the cornea is not affected, and the acuteness of vision is not impaired. The congestion is limited to the conjunctiva, and the distended vessels can be emptied for a moment by pressure through the lower lid, so as to reveal a glimpse of the white sclerotic underneath.

---

[1] *See* also VISION, Disorders of; OPHTHALMOSCOPE; and OPHTHALMOSCOPE IN MEDICINE.

In mild cases conjunctivitis is an unimportant affection, but in its more severe forms it is attended by two distinct sources of danger. During its acute stage it may produce partial or complete necrosis of the cornea, leading to great impairment of sight and not seldom to blindness; and when chronic it often occasions great hypertrophy of the papillæ of the portion of the membrane which lines the lids. These papillæ may even become converted into shaggy or warty excrescences, which mechanically irritate the corneal surface, and cause the development of vessels beneath its epithelium. In time the papillæ dwindle, and the effusion round about them contracts, thus rendering the tarsal cartilage (especially that of the upper lids) incurved, and bringing the cilia to rest upon the surface of the eyeball. Great distress and permanent impairment of vision may be thus occasioned; and the progress of the contraction may be so slow as to deprive it of any manifest connexion with the inflammation in which it had its origin.

The chief varieties of conjunctivitis are: (*a*) *infantile;* (*b*) *simple* or *catarrhal;* (*c*) *contagious;* and (*d*) *diphtheritic.*

(*a*) *Infantile Conjunctivitis.*—SYNON.: *Ophthalmia neonatorum.*

ÆTIOLOGY AND SYMPTOMS.—Infantile conjunctivitis is probably due, in most cases, to direct inoculation with vaginal secretion. It usually commences on or about the third day after birth, and passes rapidly into the purulent form. It is attended by considerable puffy swelling of the lids, and by profuse thick discharge, which soon dries upon the tarsal margins, and often causes them to cohere. If neglected or improperly treated, the disease often leads to sloughing of the cornea; but it may always be cured if it is seen while the cornea is still bright.

TREATMENT.—The treatment required is to wash away the discharge carefully and frequently; to apply an astringent lotion (the best is a solution of two grains of nitrate of silver to an ounce of distilled water) to the conjunctival surface every four hours, or less frequently when improvement is established; and to anoint the edges of the lids with simple ointment to prevent their agglutination. In cases of inherited syphilis mercurial inunction should be prescribed. The infant's food must be carefully regulated if it is brought up by hand; and if it is very feeble, it may take a little cod-liver oil, combined in an emulsion with two-minim doses of liquor cinchonæ. Where the mother's milk fails, it is often desirable to obtain a wet-nurse; but the local treatment is that which is chiefly important, and upon which, in most cases, entire reliance may be placed.

(*b*) *Simple* or *Catarrhal Conjunctivitis.*

ÆTIOLOGY AND SYMPTOMS.—This form of conjunctivitis is usually due to exposure to cold or to some chemical or mechanical irritant. Its most distinctive character is that the discharge is chiefly mucous, and has not much tendency to become purulent.

TREATMENT.—In every case the surface of the eyeball, and the lining membrane of the lids, should be carefully examined for any foreign body which may be the cause of the trouble; and if such should be found and removed, there will seldom be need for further treatment. If there is no foreign body, the two-grain solution of nitrate of silver, or of sulphate of zinc, may be placed within the conjunctival sac, by means of a quill or dropping-bottle, every two or three hours, and speedy recovery will usually be the result. In cases of very mild type, one or two applications of the astringent may be sufficient; and these may be supplemented by the use, in the same manner, of a solution of cocaine with boric acid. A good formula for this purpose contains two grains of cocaine hydrochlorate, and four of boric acid, to the ounce of distilled water. During the treatment the eyes should have functional rest, and should be sheltered from external cold, from dust, and from glare.

(*c*) *Contagious Conjunctivitis.*—SYNON.: Purulent Ophthalmia.

ÆTIOLOGY AND SYMPTOMS.—In this form the discharge rapidly assumes a purulent character. This may happen when the simple form is aggravated by the state of the patient or by accidental circumstances; or when the disease is produced by inoculation with the discharge from a similar case, or with contagious pus from the urethral or vaginal mucous membrane. The state of the patient which is most likely to promote the development of the contagious form is that in which the conjunctiva is beset with the granular semi-transparent bodies, formed by aggregations of lymph-corpuscles, which are known as 'sago-grains' or follicular granulations. These bodies are commonly present in the eyelids of persons (especially of young persons) who are crowded together under insanitary conditions of living, as in barracks, camps, or badly regulated schools; and their presence renders the conjunctivitis of simple irritation prone to assume a purulent character. It is impossible to say how soon the discharge of conjunctivitis becomes contagious, or capable of reproducing the disease in others; but its activity in this respect seems to bear some proportion to the intensity of the inflammation which produces it; and the activity of gonorrhœal pus is probably greater than that of any conjunctival product. In the more intense forms of purulent ophthalmia there is great swelling of the lids and of the ocular conjunctiva, early chemosis, and a tendency to speedy sloughing of the cornea; while the milder forms pass into the catarrhal by imperceptible gradations.

TREATMENT.—In the space available for the purpose in these pages, the treatment of contagious conjunctivitis cannot be described in detail. It mainly rests upon the action of local astringents, graduated in strength according to the severity and the stage of the disease. In the worst cases the eyelids must be everted, and the whole of the palpebral conjunctiva carefully touched with a stick composed of one part of nitrate of silver fused with four parts of nitrate of potash. The caustic should be neutralised by a drop or two of a solution of common salt, applied by means of a camel's-hair pencil, before the lid is suffered to return into contact with the cornea; and the cauterisation must be done carefully and with a light hand, so that the resulting eschar may include only the epithelium; for if the basement membrane is destroyed, there will be danger of subsequent adhesions between the eyelids and eyeball. The cauterisation should be repeated about every eight hours, or as soon as the eschar falls, and in the intervals, if the patient is awake, the conjunctiva should be gently sprayed or syringed every hour with a weak antiseptic lotion at a comfortable temperature. Diluted Condy's fluid, solution (1 in 5,000) of mercuric perchloride, or (15 per cent.) of Barff's boroglyceride, are all suitable for this purpose. The tension of chemosis may be diminished by radial incisions, outwards from the corneal margin, carried nearly down to the sclerotic. The strength must be supported by good diet and tonics; and the nervous system calmed by anodynes. In milder cases the principle of treatment must be the same, but the local applications less severe; and in chronic cases the local applications must be continued, after apparent recovery, so long as any residual thickening, capable of undergoing eventual contraction, can be found lurking in the palpebral folds.

(*d*) *Diphtheritic Conjunctivitis.*— This malady has chiefly been made known to us by the observations of German writers, and very few authentic instances have been recorded in this country. But it has from time to time prevailed extensively in Berlin, and might at any time make its appearance amongst ourselves. The writer has seen one remarkable instance in which the disease occurred with great severity in a child, whose eyes were bathed with milk as a domestic remedy for what seems to have been a mild ordinary conjunctivitis; and the coincidence seems to have a special interest in relation to recent researches into the ætiology of diphtheria.

SYMPTOMS.—Diphtheritic conjunctivitis is attended with great heat and pain, and with very hard, brawny swelling of the eyelids; but its most characteristic symptom is the infiltration of the sub-conjunctival tissue by the so-called diphtheritic effusion, which does not form a pellicle upon the surface, but distends and fills the cavities of the areolar tissue. The result is to produce a pale, firm swelling of the conjunctiva, and a great tendency to rapid sloughing of the cornea. The subjects of the malady are mostly feeble and badly fed children, and the cases are described as being almost hopeless unless early admitted into hospital.

TREATMENT.—The indications for treatment are chiefly to support the strength by suitable regimen; to apply ice or bags of freezing mixture to the lids during the hot stage; and to change the cold applications for hot ones as soon as the period of resolution, absorption, or repair can be said to have commenced. In the meantime iron and quinine should generally be administered internally.

Pemphigus of the Conjunctiva.—A very formidable, but fortunately rare, variety of conjunctival disease appears to be a kind of pemphigus. *See* PEMPHIGUS.

ÆTIOLOGY AND SYMPTOMS.—In its early stage pemphigus of the conjunctiva displays itself by the formation of bullæ, which are of small size and inconspicuous, and are seldom followed by the raw surfaces commonly left elsewhere. This stage seldom excites much attention, and it is followed by a slow process of conjunctival atrophy, which, in time, leads on to disturbance of the corneal epithelium, and ultimately to complete opacity. The conjunctival atrophy gradually obliterates the folds of the membrane, and renders the lids immovable upon the globe, frequently causing also inversion of cilia, which add to the pre-existing irritation.

TREATMENT.—The only hope of dealing successfully with conjunctival pemphigus appears to depend upon the early recognition and constitutional treatment of the general malady; for which purpose the chief reliance must be placed upon the preparations of arsenic, in combination with tonics and anodynes. When the period of atrophy has commenced, it is seldom, if ever, arrested. The apparent adhesions between the lids and the globe often suggest operative measures, but these are not recorded ever to have been successful. In one case, the writer dissected off the whole of the affected conjunctiva of the globe, and replaced it by transplanting that of a rabbit. The graft united well, and, for a time, the disease appeared to be arrested. In a few weeks, however, or as soon as the graft had become completely dependent upon the nutritive processes of the patient, the new structure became affected by atrophy, and the malady pursued its usual destructive course.

2. *Episcleritis.*—An affection which is apparently but not really conjunctival, being situated in the tissue between the conjunctiva and the sclerotic, is that which has received the name of *episcleritis*, and which was formerly described as 'sclerotitis with inflammation of the insertion of a rectus muscle.'

Symptoms. — It appears as an elevated patch of congestion, gradually passing into the natural level and appearance of the parts, and seated on the ocular surface near the corneal margin, most frequently on the temporal side. On close examination, the congestion, with the exception of a few dilated vessels, is seen to be sub-conjunctival, and to be attendant upon a circumscribed but not sharply defined swelling or thickening, which is adherent to the sclerotic, and which presents, in the interstices between the blood-vessels, an appearance as if it consisted of some new deposit, generally of a yellowish tint, external to that membrane. The swelling is indolent, chronic, and in itself generally painless, although it is sometimes accompanied by severe neuralgia. The subjects are most frequently women, especially such as are anæmic or otherwise out of condition. Episcleritis may last for months with little change, and it seems to be harmless as regards the other structures of the eye.

Treatment.—The writer has found episcleritis resist all medication except the internal administration of mercury, to which it will often yield in the course of a short time. The best preparation is the perchloride, in doses not exceeding $\frac{1}{16}$ of a grain, which may usually be combined with five or ten minims of the tincture of perchloride of iron, and often with quinine. At the same time it is often desirable to sprinkle a little dry calomel over the swelling once in twenty-four hours; but this application is less important than the internal treatment, and should not be continued unless it is soon and distinctly beneficial. When the congestion of the patch is considerable, the action of other remedies will often be promoted by the occasional application of a leech to the temple of the affected side.

3. *Hæmorrhage.*—Effusion of blood beneath the conjunctiva may occur spontaneously, but is generally traceable either to a direct injury or to violent exertion. Thus it may follow slight blows upon the eyeball, as from a twig or switch; or may be produced by a paroxysm of coughing, especially in pertussis; or may occur from the rupture of a vessel during parturition, or upon lifting a heavy weight. It is always unsightly. When traceable to any of the foregoing causes, the hæmorrhage is usually a matter of no moment; but when it happens during the night in young people, it should lead to a suspicion of nocturnal epilepsy, which has often been first discovered by its means. Moreover, in advanced life, more especially when occurring without adequate cause, it may point to arterial brittleness, of a kind which may indicate danger of a like hæmorrhage within the cranium. On these grounds it is a symptom which always calls for full inquiry into its causes, and which may sometimes afford useful warning of impending danger.

Treatment.—Absorption may be promoted by covering the closed lids by a compress moistened with a lotion of spirit and water, or of tincture of arnica and water if an appearance of more decided medication is desired.

II. Diseases of the Cornea.—Diseases of the cornea, as already indicated, are often secondary to those of the conjunctiva, and may arise in their course as complications.

1. *Ulceration.*

Ætiology and Symptoms.—To the present group belong all the corneal ulcerations of purulent ophthalmia, whether infantile or of a later period of life; and also the forms of corneal ulcer which are produced by the friction of eyelids rendered rough by inflammation, or by the friction of eyelashes which have been turned inwards by distortion of the tarsal cartilage. When ulceration of the cornea occurs in the course of conjunctivitis, it at once invests the latter malady with a highly formidable character. The corneal tissue, once destroyed by ulceration, is not reproduced in its original transparency, but only as a more or less dense and opaque white cicatrix, which is at the same time disfiguring to the appearance and an impediment to vision. If the ulcer should perforate, the iris almost necessarily becomes adherent to the cicatrix; and if the loss of substance is of large superficial extent, the resulting cicatrix is often thin and feeble, so that it is rendered prominent by the pressure within the eye, producing the condition which has been called 'staphyloma,' and gradually elevating and distorting the surrounding portions of clear cornea. The first effect of the healing of a corneal ulcer is generally to flatten the natural curvature of the membrane; but the secondary effect, if the cicatrix becomes prominent, may be to modify this curvature in various ways. Hence it follows, even when a cicatrix of the cornea is surrounded by a still transparent annulus, behind which an artificial pupil may easily be made by the excision of a portion of the iris, that the surgeon cannot predict with any certainty the quality of the vision which will be obtained, unless he is able, before operating, to determine the state of the corneal curvature. This is only possible when the margin of the pupil is so far free that it can be dilated with atropine sufficiently to render the fundus of the eye visible with the ophthalmoscope. When this can be done, any portion of cornea through which a clear view of the retinal vessels can be obtained by the surgeon will also afford clear vision of external objects to the patient; but, if no such place can be discovered, a very cautious opinion should be given with regard to the degree of benefit which may be hoped for from an operation.

Treatment.—The extreme importance of the cornea to the visual function renders it necessary that its integrity should be guarded with the greatest possible care. In any case of conjunctivitis, of even moderate severity, the cornea should be watched from day to day, and any appearance of turbidity about its central portion, or of elevation or irregularity of the epithelium at its margin, should lead to a reconsideration of the treatment which is being pursued. The former of these conditions is the ordinary precursor of sloughing ulcer or necrosis; the latter, of the extension to the cornea of an inflammatory process.

The general principles which govern the treatment of sloughing ulcer are, that the eye should be kept under the influence of eserine, which has a marked effect in checking the extension of ulceration by arresting the migration of white corpuscles; that any astringents which may be applied to the conjunctiva should be prevented from coming into contact with the cornea; that strength should be supported, pain relieved, and local nutrition stimulated by hot applications. When the ulcer continues to spread, its progress may often be arrested by diminishing the tension of the globe by the evacuation of the aqueous humour; and this may be accomplished either by repeated paracentesis at the corneal margin, or by Saemisch's method of cutting through the base of the ulcer, and reopening the incision daily until a process of repair is well established, or by the performance of iridectomy. Of these three courses, the last-named is the most generally applicable. It not only produces the immediate effect which is desired, but it has also the incidental advantage of establishing an artificial pupil at the side of the cicatrix.

The application of eserine is best effected by using a solution of the neutral sulphate, of the strength of four grains to the ounce of distilled water; and a drop of this solution may be placed within the conjunctival sac twice or thrice daily.

The sloughing ulcers of the cornea which arise from causes other than conjunctivitis, as injury, or failure of nutrition, must be treated upon the principles which have already been laid down. There are, however, inflammatory ulcers which require the use of local applications of a stimulating kind, among which dry calomel and other mercurials hold a prominent place. Such ulcers have usually a leash of vessels running from the corneal margin, and are often obstinately recurrent; whence they are known as 'recurrent vascular ulcers.' They are usually connected with some manifest systemic derangement, and are often attended by photophobia. They leave scars upon the cornea, of a size and opacity proportionate to their extent and depth; and on this account it is desirable, whatever constitutional treatment may be required, to heal the ulcers themselves as speedily as possible, by the aid of local applications. In the early stages of the ulceration, eserine should be used; but afterwards either dry calomel or an ointment containing from ten to thirty grains to the ounce of the precipitated yellow oxide of mercury. This ointment was introduced into practice by the late Dr. Pagenstecher, of Wiesbaden, and is often called by his name. In very obstinate cases the late Mr. Critchett recommended setons in the temporal regions; but the operation of iridectomy will often afford a still more efficacious remedy. Where there is much photophobia, the use of eserine is especially indicated, because, in addition to its action above mentioned, it produces contraction of the pupil, and thus gives comfort by lessening the quantity of light which is admitted into the eye. If the photophobia is very severe or intractable, it is often beneficial to divide the orbicularis muscle freely at the outer canthus, so as to diminish the pressure which is caused by its spasmodic contraction, and which sometimes seems to be a chief cause of the irritability. After such an incision, a cold compress should be applied, and the patient kept in the dark for a few hours, when there will often be a marked alleviation of this distressing symptom, and a greatly increased general amenability to treatment.

2. *Inflammation.*— Synon.: Keratitis.— Inflammation of the cornea presents three distinct types, the *suppurative*, the *vascular*, and the *interstitial*.

(*a*) *Suppurative Keratitis.*—Suppurative inflammation or abscess of the cornea seems to be essentially a phlegmon or boil of the corneal tissue, a portion of which dies, and is cast off in the form of a slough.

Symptoms.—The abscess commences as a very tender grey spot in the cornea, surrounded by a zone of turbidity, and accompanied by a good deal of ciliary neuralgia, as well as by a variable degree of lacrymation, conjunctival congestion, and intolerance of light. Under the influence of atropine, hot fomentations, and such constitutional treatment as the state of the patient may demand, the threatened suppuration is sometimes averted, and the turbidity clears away. More commonly pus is formed, and makes its way either externally, leaving an ordinary ulcer; or internally, producing the condition called *hypopyon*, in which there is pus in the anterior chamber. Sometimes it separates the corneal laminæ, by gravitation, to a considerable extent before perforating them, and is then called *onyx*, from a resemblance to the lunula at the base of a finger-nail.

Treatment.—When suppuration is no longer doubtful, the best practice is to evacuate the abscess by a puncture from within, by thrusting a cutting needle into the anterior chamber near the corneal margin, and then causing its point to penetrate the cavity of the abscess. The mingled pus and aqueous humour will escape as the needle is withdrawn, and its wound of entrance may be reopened once or twice daily by a probe, so as to insure the complete removal of all inflammatory products, until the healing process has made some way. If the abscess has burst internally before the case is seen, atropine should be applied without delay. If the pupil dilates fully, and the quantity of pus in the anterior chamber is but small, the case may be left to the *vis medicatrix naturæ*, care being taken to enforce rest and to exclude noxious influences. If the quantity of pus is large, it should be let out by paracentesis; and if the atropine reveals adhesions of the iris, iridectomy should at once be performed. An abscess which has burst externally leaves simply an ulcer, generally with a disposition to heal readily, and requiring only such treatment as has already been described.

(*b*) *Vascular Keratitis.*—Vascular inflammation of the cornea is often a very severe and protracted malady, which usually leaves behind permanent opacity and impairment of sight.

Symptoms.—It commences, in typical cases, by the formation of two crescent-shaped patches of vascularity, one at the upper and the other at the lower portion of the cornea. The patches are formed by the development on the corneal surface of innumerable fine blood-vessels, so closely packed together that the interstices which separate them are scarcely discernible by the naked eye, and the affected parts present a uniform aspect of vivid redness. The crescents are somewhat elevated above the general corneal surface, and each crescent is bordered, along its concave or advancing edge, by a line of precursory epithelial turbidity. At the same time that the crescents increase in size, the borders of precursory turbidity are pushed before them; until at first these, and afterwards the crescents themselves, may meet and coalesce on the horizontal diameter of the cornea, so that its whole surface may become uniformly red. When this stage is reached, vision is almost abolished, but there may still be much intolerance of light. The corneal tissue is softened, and its margin is surrounded by a zone of sclerotic vascularity, which is visible through the congestion of the conjunctiva. As the inflammation subsides, the vascular crescents slowly recede from the centre of the cornea towards its circumference, and finally disappear, leaving behind them a dense opacity of an extremely obstinate character. A severe case of vascular keratitis generally affects both eyes, and threatens a long period of actual blindness, followed by a long period of very imperfect vision. The worst examples of the malady are those which have been treated at the outset by astringent or irritating applications; and, even in the slighter forms, the malady is nearly always obstinate and protracted. As long, however, as the march of the vascular crescents, or their precursory turbidity, has not encroached upon the portion of cornea in front of the pupil, so long vision is not seriously jeopardised.

Treatment.—The great object of treatment is to arrest the new vascular development at a comparatively early stage; and for this purpose it is necessary to have recourse to eserine and sedatives locally, and to such constitutional treatment as the general condition may require. A solution of two grains of the neutral sulphate of eserine, with from two to four grains of hydrochlorate of cocaine, in an ounce of distilled water, should be dropped into the eye twice daily, and the closed lids should be frequently fomented with hot poppy decoction, or with cold solution of extract of opium in water, according as one or the other temperature is the more agreeable to the feelings of the patient. Apart from any special indication, the medicines most generally useful are those which appear to influence local nutrition through the central nervous system, such as the iodide and bromide of potassium, and the sulphate of quinine. These, if they are likely to exert a beneficial effect, generally do so speedily; and if the malady should be rapidly extending, it is always prudent to reconsider the prescription without much loss of time. In severe cases, especially when the lids are somewhat tumid and there is much photophobia, a leech may often be applied with advantage, usually over the temporal muscle, close to the outer margin of the orbit, or a little blood may be taken more rapidly, by means of Heurteloup's artificial leech; and when, notwithstanding treatment, the malady pursues its course unchecked, a large iridectomy should be made without undue delay. The operation not only tends to arrest the vascular formation, but it also leaves a lateral pupil through which good sight may often be obtained long before the transparency of the central parts of the cornea is restored. In some cases, the writer has seen excellent results from peritomy; that is, from excising the annulus of conjunctival and subconjunctival tissue which immediately surrounds the cornea. The strip excised should be about 3 mm. in width; and the excision may sometimes be limited to the bases of the vascular crescents.

Development of vessels upon the cornea.—It is necessary carefully to distinguish vascular keratitis, properly so called, from that development of vessels upon the cornea which may occur in connexion with the cicatrisation of ulcers, or in consequence of the friction of lids left granular by conjunctivitis. In both these forms the new vessels are arborescent and irregular in their distribution, instead of being closely packed together; and they are not attended by the pink zone of circumcorneal congestion, which is never absent in true corneal inflammation.

The vessels which attend the formation of cicatrices generally dwindle in course of time; while those produced by granular lids, and which, when they are very abundant and closely set, constitute the condition called *pannus*, will often disappear without direct treatment if the state of the lids themselves can be favourably modified by the application of astringents or by other means. When residual granulations are large and numerous, they may be treated by crushing them with forceps, by scraping, or by electrolysis; for which purpose they should be separately punctured by a platinum needle, connected with the negative pole of a galvanic battery. A weak current only is required, and it may be suffered to pass through each granulation for from ten to twenty seconds. In many cases the vascular network of pannus will be comparatively absent from the lower third of the cornea, so that sight may be much improved by an artificial pupil made in a downward direction. When pannus covers the whole cornea with a close vascular network, so that sight is almost destroyed, and when it resists milder treatment, it may sometimes be cured by inoculation with the discharge of infantile purulent ophthalmia. The pus is inserted between the lids, and the artificial malady suffered to run its course unchecked, except by cleanliness and frequent bathing. When the discharge has ceased, the cornea will often clear in a surprising manner, and its abnormally vascular state protects it, to a very great degree, against the risk of sloughing. Still, this risk is by no means absent, and the treatment by inoculation should be regarded only as a last resource. A somewhat similar effect may be obtained by the inflammation which is excited by bathing the eyes with an infusion of the seeds of jequirity; but this method is scarcely less dangerous than that by inoculation.

(*c*) *Interstitial Keratitis.*—This is a chronic malady which is seen chiefly, or perhaps exclusively, in the subjects of inherited syphilis, who possess the peculiar teeth and *facies* which Mr. Hutchinson has shown to be characteristic of their inheritance. The disease was long described as a variety of 'strumous ophthalmia;' and, although the late Sir William Wilde pointed out how frequently it was associated with deafness, and also laid stress upon the value of perchloride of mercury in its treatment, its syphilitic character seems to have been first suspected by Mr. Hutchinson, who, having once obtained the clue, followed it with characteristic diligence until he arrived at a conclusive demonstration of the accuracy of his suspicion.

Symptoms.—Interstitial keratitis commences as a slight cloudiness of the central portion of the cornea, with some roughening or irregularity of the epithelium. It extends from the centre towards the margin, and is liable to be attended, in different cases and at different stages of its course, by variable degrees of ciliary and corneal congestion, and intolerance of light. If neglected, or if treated by irritants, it is liable to assume the characters of vascular keratitis, and also to extend to the iris, in such instances often doing irreparable mischief. It is most common during childhood, but its appearance may be delayed until adolescence, or even until adult age; and, in such cases, usually appears to be determined by some general or local exciting cause, such as bodily illness, or direct injury. It attacks both eyes, one commonly somewhat later than the other, and its course is often protracted over several months. When severe, it leaves some residual cloudiness of the cornea, and, even when mild, it is doubtful whether the cornea ever entirely regains the transparency of health. Still, when a case is seen and judiciously treated early, the prognosis may generally be a favourable one.

Treatment.—The treatment consists primarily in the avoidance of all irritants; the use of eserine and local sedatives, especially cocaine; and the administration of perchloride of mercury, or of iodide of potassium, with or without iron or cod-liver oil. When they are not contra-indicated by any special circumstances, the perchloride of mercury and the oil are the remedies on which the greatest reliance may be placed. The earliest indications of photophobia, showing, as they do, that light is acting as an irritant, should be met by confinement to an almost darkened room, and by frequent bathing of the closed lids with cold water; but in fine weather daily exercise should be taken in the open air, the eyes being covered for the time with a black silk bandage and compresses of carded wool, so as to exclude light entirely. As soon as photophobia subsides, these precautions may be left aside—the eserine and mercury being still continued, at least until the acute stage of the malady has entirely passed away. After this the absorption of residual opacity may be promoted by the application, once daily, of a morsel of an ointment containing a small quantity (about ten grains to an ounce) of the precipitated yellow oxide of mercury.

In cases which have been neglected, or aggravated by irritants in their early stages, and in which the phenomena of ordinary vascular keratitis become grafted upon the interstitial, it is generally desirable to perform iridectomy with as little delay as possible.

3. *Arcus Senilis.*—The condition thus named (although the adjective is not always appropriate) is fully described elsewhere (*see* ARCUS SENILIS). It may be distinguished from the peripheral zones of opacity, which are sometimes left after the subsidence of certain forms of keratitis, by the circumstance that arcus never extends quite to the margin of the cornea, but is always surrounded by an annulus of transparent tissue.

Besides the foregoing, there are a few other forms of corneal disease, of comparatively rare occurrence, which it would be beyond the limits of these pages to describe, but which must be treated on the same general principles; and there is also the malformation known as 'conical cornea,' which falls wholly within the domain of surgery.

III. Diseases of the Sclerotic.—Diseases of the sclerotic, which were once regarded as a numerous and important group, have been reduced by recent investigations to comparatively insignificant proportions.

Inflammation. — SYNON.: Sclerotitis. — Excepting in a narrow annulus immediately around the cornea, the sclerotic is almost extra-vascular; and any real inflammation of its structure is almost confined to this particular region, where it seldom occurs excepting as a complication or as a part of some of the more severe forms of iritis or keratitis, especially when either of these affections extends to the ciliary body. In such cases we often see the sclerotic undergo inflammatory softening, as a result of which the ciliary region may be much altered in shape, yielding to the distension of the eyeball and to the traction of the recti muscles, and becoming distinctly elongated. Occasionally the sclerotic may be so much softened and thinned as to bulge into irregular prominences around the cornea, generally under the upper lid; and this condition is described as *sclerotic staphyloma.*

TREATMENT. — The inflammations thus arising call for no other treatment than that which is demanded by the more important inflammations of the cornea, the iris, or the ciliary body, with which they are associated; except that any evidence of yielding of the sclerotic would be a reason in itself for the performance of iridectomy, in order to preserve the shape of the eyeball by diminishing its tension. It was once believed that the sclerotic, in its character of a fibrous membrane, was especially prone to gouty or rheumatic inflammation; and it is perhaps true, though certainly not proven, that the tendency of iritis or of keratitis to spread to the anterior sclerotic zone is more marked in persons of gouty or rheumatic diathesis than in others. The possibility is at any rate sufficient to require, in all these cases, an investigation of the tendency to lithic acid formation, and the use of appropriate remedies when this tendency is discovered. But a large proportion of the examples of supposed gouty or rheumatic ophthalmia are nothing more than cases of the sub-acute or remittent form of glaucoma; and the pain associated with them is not really rheumatic but simply tensive. Vision has been irretrievably lost, in hundreds of instances, because a belief in the rheumatic character of these affections has interfered with the timely performance of iridectomy; and the proposal to adopt the epithet 'rheumatic,' in any form of eye-disease, is one which should be scrutinised very closely before it is accepted as a guide to practice.

IV. Diseases of the Iris.—In so far as they come into the province of the physician, diseases of the iris are not numerous, and are almost limited to the varieties of inflammation of that membrane.

1. *Inflammation.*—SYNON.: Iritis.—Iritis may be classified, according to its actual or supposed causes, as rheumatic or syphilitic; or according to the nature of the morbid process, as *plastic*, *serous*, or *suppurative*. The former classification must often rest upon very slender grounds, and the latter has the great advantage of expressing facts rather than inferences.

(*a*) *Plastic Iritis.*—SYMPTOMS.—In plastic iritis the first symptom is usually some loss of the natural lustre of the surface of the iris, and of the clear definition of its fibres, together with some damping or alteration of its colour. These changes are probably always due to turbidity of the aqueous humour, and they may be imitated more or less closely by turbidity of the cornea, and especially by disturbance of its epithelium. In iritis, however, they are associated with a diminished range and quickness of pupillary variation under variations of light; and, in a short time, with the effusion of plastic lymph, by which the margin of the pupil becomes tied down, here and there, to the surface of the anterior capsule of the crystalline lens. At the same time there is usually some congestion of the conjunctiva, and of the zone of fine vessels immediately around the cornea in the sclerotic. There is frequently more or less pain, especially towards night, but this is a very uncertain symptom. In severe cases, and especially in such as are clearly syphilitic in their character, the quantity of effused lymph may be very considerable, so as quite to cover the pupil, while in mild cases it is only sufficient to fasten down the margin here and there. Iritis is sometimes a very insidious and seemingly slight affection, the real gravity and importance of which may be wholly overlooked by the patient.

TREATMENT.—The first principle of treatment is to prevent the formation of adhesions, or to break them if they have been formed; and for this purpose our main reliance must be placed upon the instillation of atropine. The anatomical structure of the eye is such that a moderately contracted pupil is in contact with the lens-surface, while a fully dilated pupil is separated from it by a film of aqueous humour. Hence, as long as the pupil is contracted, any lymph which is effused tends to the immediate formation of adhesions; while, as soon as the pupil is dilated, the lymph diffuses itself harmlessly in the surrounding fluid, and no adhesions are produced. In ordinary circumstances, and in cases of only ordinary severity, the iritis then runs its course without inflicting any permanent injury, and vision is completely restored as soon as resolution has taken place. When, on the contrary, the pupil cannot be dilated, the lymph deposited in the area of the pupil forms an impediment to vision; and the adhesions themselves tend to render the iritis a recurrent affection, which is apt to return again and again until the eye is disorganised and destroyed.

The first principle of treatment is, therefore, to produce and maintain dilatation of the pupil; and for this purpose it is necessary to use some active mydriatic. The neutral sulphate of atropine is usually the most convenient agent for the purpose, and it should be used in a solution containing four grains to the ounce of distilled water. The pharmacopœial solution of atropine, which contains spirit, should be avoided on account of its irritating action. Of the pure watery solution, a drop should be carefully placed within the lids by a dropping-tube or quill, repeated in five minutes, and again in another five minutes, and this threefold application should be repeated three times a day. A mydriatic agent still more powerful and more rapid in its action than atropine has lately been introduced into practice in *duboisine*, the active principle of an Australian shrub, Duboisia myoporoides. Duboisine should be used in a watery solution, of the strength of four grains to the ounce; and it is said to have less tendency than atropine to produce local irritation. The hydrochlorate of cocaine may be combined in solution with either of the foregoing, and will not only assist their mydriatic action, but will also greatly promote the comfort of the patient. If the pupil can be fully dilated in twenty-four hours, no other treatment will be necessary than to maintain the dilatation by using the mydriatic less frequently, and to protect the eye from being injured by exertion, or by exposure to great variations of temperature or of light. If, on the contrary, after the use of atropine or duboisine for twenty-four hours, the pupil either remains contracted or dilates irregularly, showing that it is bound down here and there, it is necessary to have recourse to mercury without further delay, and to use one of the preparations, such as blue pill or calomel, with which the effect of the medicine upon the system can be rapidly secured. There is never any occasion to carry the effect of the mercury farther than to the formation of a slight line upon the gums; and, in most cases, as soon as this line is perceptible, a notable amelioration of the eye-symptoms will be observed. It is desirable, however, that this degree of mercurial influence should be reached quickly, in order to cut short the disease as soon as possible; and when it has been reached, it will usually require to be maintained, for some days at least, by the administration of smaller and less frequent doses. In favourable cases, under the combined influence of mydriatics and mercury, the effused lymph will be absorbed, the adhesions broken through, and the eye restored to its original condition. In those of a less favourable character, the inflammation will, indeed, subside; but the adhesions will remain, and the pupil will be left permanently more or less crippled and distorted. Whether or not sight will be impaired will chiefly depend upon whether the effused lymph has formed a film or membrane across the pupillary opening. In the worst cases, notwithstanding treatment, the inflammation may extend to the ciliary body and choroid, and may produce functional destruction of the eye. This scarcely happens except when the iritis has been of great original severity, and when it has been neglected, or aggravated by irritants, in its early stages. Even the suspicion of iritis should absolutely preclude the use of the astringent applications on which we have mainly to rely in the treatment of the inflammations of the conjunctiva.

If an iritis is not seen until it has been three or four days in existence, so that the adhesions have had time to acquire a certain degree of firmness, it is not desirable to wait twenty-four hours before having recourse to mercury. The mineral should be given without further delay, so that it may be abandoned if atropine should dilate the pupil, and may be pushed if dilatation cannot be produced.

While the atropine, or atropine and mercury, are being employed, the remainder of the treatment must be governed by general considerations. Rest of the other eye must be strictly enforced; local depletion may be practised whenever the congestion is considerable in degree; and such a regimen and mode of life must be prescribed as the patient can bear. Unless there is photophobia, it is seldom or never necessary to exclude light altogether from the eye; and, when photophobia is present, it is better to apply a protective bandage than to keep the patient in a dark room. The latter practically excludes him from cheerful companionship, and leaves him to dwell upon his troubles in darkness and solitude. Pain, if present notwithstanding the use of cocaine, should always be subdued, either by combining a sufficient dose of opium with the mercury, or by the subcutaneous injection of a solution of morphine. However the anodyne is administered, provision should be made for repeating it sufficiently often to produce and maintain the desired effect.

When recovery takes place leaving adhesions, these will, in the majority of cases, lead to a second attack of iritis, and this is almost always the predecessor of regular recurrence. In a few cases, however, the second attack does not follow; but, whenever it occurs, the tendency to future mischief should be stopped by surgical means, either by the detachment of the adhesions or by the performance of iridectomy.

(*b*) *Aplastic Iritis.*—The aplastic form of iritis differs from the plastic in the greater quantity and the more liquid condition of the effusion, which does not form adhesions, but distends the eyeball and compresses its contained structures. In a well-marked case the pupil is contracted and insensible to atropine (which in all probability is not absorbed); the aqueous humour is turbid; the iris is pushed back and its anterior surface appears concave; vision is greatly impaired; and the eyeball is perceptibly hardened to the touch.

TREATMENT.—Until the distension is relieved, no remedies will be effectual; and, when it is relieved, they generally cease to be needed. The treatment should be either by frequently repeated paracentesis of the anterior chamber or by a large iridectomy or sclerotomy, and the latter is generally to be preferred. Aplastic iritis occurs chiefly in persons of unhealthy or broken-down constitution; which may perhaps account for the unorganisable character of its products. As soon as the distension of the eyeball is relieved, the pupil is readily dilated, and the iritis soon subsides.

(*c*) *Suppurative Iritis.*—In a small number of cases iritis assumes from the first a suppurative character, and leads to the formation of pus in the anterior chamber.

TREATMENT.—Such a condition calls for atropine; for stimulating and tonic medicines rather than for mercury; and for the evacuation of the pus by paracentesis if it is considerable in quantity, or if its presence appears to be a source of increased irritation.

(*d*) *Serous Iritis.*—This term, which would perhaps be more appropriately used for the aplastic form of iritis, has been applied by continental writers to a form of disease which was described in old books as 'aquo-capsulitis,' and in which the posterior surface of the cornea participates with the iris in the inflammation.

ÆTIOLOGY AND SYMPTOMS.—Serous iritis usually first attracts attention by occasioning a slight dimness of vision. There will often be no congestion, or scarcely any, but the movements of the pupil will be sluggish, and careful examination will discover one or more fine points of adhesion to the anterior capsule. But the most characteristic appearance of the disease is situate upon the lining membrane of the cornea, which will be found covered by a number of minute circular dots, ranged in a pyramidal outline. The base of the pyramid corresponds with the lower corneal margin; the apex encroaches more or less upon the pupillary region. As the disease progresses, the dotted pyramid increases in density and conspicuousness, and the pupillary adhesions increase in number and extent. The malady usually runs a very chronic course, and often leaves some permanent diminution of vision. In a certain proportion of cases it seems to be independent of any known cause; in others it follows some constitutional affection (the writer has seen a very severe case, in a young lady, consecutive to mumps); in others it is associated with constitutional syphilis. After injury to an eye, serous iritis sometimes appears in the other as the first stage of sympathetic ophthalmia.

TREATMENT. — This will include, in the first place, careful consideration of the state of the general health, and endeavours to correct whatever may be amiss. The eyes should be kept at rest, the pupils dilated but protected from bright light, and mercuric chloride, or iodide of potassium, or both, may be given in suitable doses, the efficacy of these remedies being manifest in the non-syphilitic as well as in the syphilitic subjects of the disease. Where the adhesions are numerous, iridectomy may be required to relieve dragging. The cases are usually chronic, and many months may elapse before the eyes are restored to usefulness.

2. *Inflammation of the ciliary body and choroid.*—SYNON.: Cyclitis; Irido-choroiditis. In some instances, which fortunately are not numerous, iritis is not confined to the membrane in which it originates, but spreads backwards to the ciliary body and the choroid. The most marked examples are those in which the original inflammation has been excited by morbid changes, resulting sometimes from disease, but more frequently from injury, in the opposite eye; and these cases are called *sympathetic ophthalmia.* They have been generally supposed to depend upon the propagation of peripheral irritation through a nervous centre, and to point very clearly to the presence of some central nerve-irritation, or functional failure, as the essential point of difference between the iritis which dies out as a localised affection, and that which spreads by continuity to the deeper parts of the eye. Recent observers have endeavoured to connect the phenomena with the presence and the migrations of microbes. However occasioned, the

issue of declared irido-cyclitis or irido-choroiditis is generally disastrous; for the inflammation is always of a plastic character, and the effused lymph is scarcely ever absorbed in time, or with sufficient completeness, to prevent its contraction from inflicting profound injury upon the visual apparatus. The perceptive layer of the retina is not only in contact with the choroid, but the rods and cones derive the materials of their nutrition from the chorio-capillaris; and hence, as regards these delicate structures, an inflammation of the choroid, upon which they are directly dependent, is of far greater importance than an inflammation of the retina itself, which may be limited to the connective tissue of the fibre layer, and may leave the precipient elements almost unaffected.

Symptoms.—The first sign of the extension backwards of iritis is usually furnished by tenderness of the ciliary zone, so that this region feels acutely the slightest touch of a probe, or of the end of a rolled paper spill, which is a more delicate instrument for testing the sensibility of the ocular surface. At the same time there is always a greater degree of impairment of vision than the iritis alone will explain, together with increased general congestion of the eye, and, in many cases, with an appearance of visible vessels on the iris.

Treatment.—The treatment to be pursued does not differ materially from that which is required by the more severe forms of simple iritis; and consists of depletion from the temple, generally by means of Heurteloup's leech; the application of atropine; the administration of mercury, both internally and by inunction upon the brow; the control of pain; and the maintenance of strength. In sympathetic cases, the eye in which the mischief originated should be removed, even although the usefulness of this proceeding is somewhat doubtful when once the secondary affection is established. It is often necessary carefully to continue the use of mercury for a long period, generally in the form of small doses of the perchloride combined with iron; and it is chiefly when this has been done that some small vestige of vision is saved out of the wreck. The lens, in such cases, often becomes coated by lymph, and ultimately requires removal; and it may be necessary to perform iridectomy for closure of the pupil more than once, in consequence of the tendency of the artificial opening to be drawn together again by contraction. On account of the severity of sympathetic ophthalmia, and of its generally unfavourable termination, it is a rule of practice to anticipate its occurrence, and to remove a diseased or injured eye which is likely to produce it, before the mischief has been done.

V. Diseases of the Crystalline Lens are separately treated of under the article Cataract.

VI. Glaucoma.—In its modern signification, this word is applied to denote all the conditions which are produced by a morbid increase of tension within the eye—that is to say, by an excess of its contained fluids; and the different forms of the affection are mainly due to differences in the rate at which the tension increases.

Symptoms.—If the increase be rapid, the loss of sight will be rapidly produced, and will be associated with other changes occasioned by sudden interference with the circulation and innervation, and by sudden stretching of the ocular tunics. When, on the other hand, the increase of tension is very gradual, so that the eye has time to become accustomed to the new conditions as they are produced, the symptoms often present a deceptive resemblance to simple atrophy; and these cases were at one time described as 'atrophy with excavation of the optic nerve.' In some of the more acute forms of increased tension, the pupil presents a clouded aspect of a greenish colour; and it was to cases of this class that the word glaucoma (from γλαυκός, sea-green) was originally applied, at a time when the pathology of the condition was not understood. When this pathology was rendered clear, and when it became known that the glaucoma of the ancients was in all essential respects identical with cases in which the most manifest symptoms were of a different kind, the word was retained as a convenient general term, to express states of disease to which it had no longer any apparent reference; and hence we still speak of glaucoma, although, in the great majority of the cases in which we do so, the green aspect of the pupil is conspicuous by its absence.

The normal tension of the eye appears to be maintained, in the face of continued internal secretion of fluid, mainly by the transudation of this fluid, at the so-called 'filtration area,' in the angle formed between the cornea and the iris, into the plexus of veins contained in the canal of Schlemm. In order that this transudation may be free, it is necessary that the angle should be open, and the access of fluid to the filtration area unimpeded. In certain relations of the lens to the neighbouring structures, and, possibly, in consequence of increased bulk of the lens in advancing life, the periphery of the iris may be so pushed forward towards the cornea as to produce partial closure of the angle, and impeded access of fluid to the filtration area. Such conditions tend necessarily to increase; and they are liable to be increased still further by dilatation of the pupil, which implies thickening of the peripheral portion of the iris, and the occupancy, by this portion, of an abnormal amount of space. At a later period, as the tension continues to increase, the peripheral portion of the iris may even be applied to the margin of the cornea after the fashion of a valve, and transudation may be completely arrested.

The estimation of increased tension by the fingers is a matter which requires the *tactus eruditus*, and is best accomplished by directing the patient to close the eyes gently, and to cast them downwards. The tips of the two forefingers should then be placed upon the upper lid immediately below the margin of the orbit, and, when one finger has fixed the eye by holding it gently back against the orbital contents as far as it will recede, the other estimates the degree in which it may be dimpled by slight pressure. This degree varies to some extent in different persons within physiological limits, but a morbid increase of tension can scarcely be missed if it is looked for. Moreover, the diagnosis of glaucoma does not rest upon increased tension alone, but upon the combination of increased tension with decreasing sight. The rate of slow increase which may simulate atrophy, or of rapid increase which may simulate inflammation, are matters of detail which should not, in either case, be suffered to obscure the true nature of the morbid process.

The symptoms of glaucoma depend upon the more or less gradual interference with the ocular circulation, and compression of the ocular nerves, by reason of increasing pressure within the eye. In consequence of the interference with the circulation, the blood enters and leaves the eyeball with difficulty. The first indication of this difficulty is afforded by the small veins which pierce the anterior portion of the sclerotic near the cornea, and course backwards beneath the conjunctiva towards the equator. These veins, which are invisible, or at least inconspicuous, in health, become distended and tortuous when the impediment to the venous outflow reaches a certain degree. At the same time, the ophthalmoscope will usually discover pulsation of the retinal vessels upon the optic disc, a pulsation first observed in the veins, and afterwards also in the arteries. It would seem that the contents of the veins are pushed back by the entering arterial current, and that the latter is only able to make good its way at the acme of the pulse-wave.

The symptoms which depend upon compression of the nerves will vary, of course, with the functions which these fulfil. Commencing with ordinary sensation, a moderate compression of the filaments derived from the fifth produces diminished sensibility of the corneal surface; while a pronounced increase of tension, especially if rapidly produced, occasions severe pain by the stretching of the ocular tunics. Proceeding to the motor filaments, compression of those derived from the third produces paresis of the ciliary muscle and of the sphincter pupillæ; the former evidenced by rapidly increasing impairment of accommodation, the latter by sluggishness and dilatation of the pupil, the dilatation usually moderate in degree, but often causing the aperture to assume an elliptical outline, with its major axis horizontal. This pupillary dilatation is apt to be increased by the forward pressure of the crystalline lens; and, however produced, it tends, in the way already described, to occasion a still further increase of tension. The compression of the retina causes impairment of visual function, first manifested in the portions most remote from the central blood-supply; and hence taking the form of contraction of the field of vision, usually first displayed and most marked on the nasal side. Contemporaneously with this, central vision will be more or less reduced; and, at the same time, the increasing intra-ocular pressure will occasion yielding from within wherever such yielding is possible, and hence chiefly over the area of the optic disc, the structures composing which will be to some extent pushed back out of the eye, leading to the formation of a 'cup' or excavation, which is one of the most conspicuous of the ophthalmoscopic signs of heightened tension. Finally, the general nutrition of the eyeball will suffer, in a manner which is often first displayed by the surface epithelium of the cornea, which is apt to become disturbed, irregular, or, as it were, 'steamy,' presenting an aspect somewhat as if it had been breathed upon, and constituting a cause of further serious impairment of the already diminished vision.

Such being the chief symptoms, one or more of which will be recognisable by examination in glaucoma, those complained of by the patient are often exceedingly characteristic. Glaucomatous tension is apt to increase in waves, separated by intervals in which it may decrease, or in which the structures pressed upon acquire some tolerance of the new conditions. We therefore often hear complaints of sudden 'clouds' or 'obscurations' of vision, which pass away after a few minutes or a few hours, and return at uncertain intervals. The intervening recovery in such cases is seldom complete; each 'cloud' usually leaving the sight permanently worse than before. The depth of the cloud, the period of its duration, and the presence or absence of pain, are conditions which will be governed by the extent and the rapidity with which tension has been increased. When the cloud has passed away, we shall usually find diminution of central vision, contraction of the field, especially on the nasal side, and sluggishness of the rather large pupil. At the same time, it will often be found that the sensitiveness of the corneal surface is diminished; and the patient will often admit, on inquiry, that artificial lights of feeble intensity—candle flames, for example—are frequently surrounded by coloured halos. But the combinations and the order of occurrence of symptoms will differ widely in different cases; and all that can be called essential, in order to constitute glaucoma, is a combination of impaired central vision and diminution of the field, with increased tension discoverable by the educated finger. When this combination is present, there should be no doubt as to the diagnosis, as there will certainly be no time to waste in inefficient treatment.

Treatment.—The treatment of glaucoma is entirely surgical, the affection being capable of arrest by iridectomy or sclerotomy in the great majority of cases. In the more acute forms, an operation, if performed sufficiently early, usually restores vision to its integrity; but the time during which this can be done is limited, and in the more chronic forms no operation will do more than preserve what amount of sight is still retained. Hence it is important that treatment should not be delayed by any error of diagnosis; and the points to which attention should chiefly be directed, in any case of impairment of vision in which the question may arise, are increasing hardness of the eyeball as determined by palpation, and gradual contraction of the field of vision. Whenever the eye is becoming harder, and the circumferential extent of vision is narrowing in, the case is one in which an operation should be accomplished with as little delay as possible. At the same time, until the operation can be performed, a four-grain solution of eserine should be applied every four hours; this drug having a marked effect in controlling and diminishing tension, and being apparently indebted for this power to its mechanical action upon the iris, which, by the contraction of the pupil, is thinned out and drawn away from the filtration area. It is hardly necessary to add that in any case of actual or threatened glaucoma, the use of a mydriatic would be highly dangerous. The more acute cases of glaucoma are attended by much pain from the distension of the ocular tunics, and often by congestion and inflammation, the results of this distension; and such cases were at one time described as 'acute internal arthritic ophthalmia,' or by some similar name. Vision has been irretrievably lost, in hundreds of cases, by endeavours to control this form of glaucoma by medical treatment, to the neglect of operation; and the erroneous practice has been kept alive by the circumstance that some of the cases will undergo partial and temporary amendment. In such circumstances, however, the vision never rises to the degree of acuteness which existed prior to the attack, and the amendment is never more than temporary. Another increase of tension soon occurs; and, without surgical aid, blindness sooner or later closes the scene.

VII. Diseases of the Optic Nerve and Retina.—As shown by the ophthalmoscope, these diseases cover a very wide field of pathology. In order to understand them accurately, it is necessary to bear in mind the anatomy and relative arrangement of the affected tissues. The optic nerve in the orbit is invested by a double sheath, and the interval between the layers of this sheath, which is continuous with the sub-arachnoid space, terminates in a *cul-de-sac* towards the eyeball, the two layers becoming intimately united where they blend with the sclerotic. At this point, the opening in the sclerotic for the admission of the optic nerve is crossed by a film of perforated connective tissue, the *lamina cribrosa*, with which the sheaths of the nerve-fibres blend, or in which they are lost, so that the nerve anterior to the lamina consists of a bundle of unsheathed fibres, enveloping the central artery of the retina, which enters the eye with them, and the central vein of the retina, which passes out in the same position. On entering the eye the nerve-fibres bend round to form the anterior layer of the retina, which contains also the retinal blood-vessels almost to their ultimate divisions, together with some delicate connective tissue. The capillary circulation of the nerve itself is derived from the anterior cerebral artery, and is distinct, save for a very slight amount of anastomosis, from the capillary circulation of the sheath, which is fed by the arteries of the pia mater. It follows that hyperæmia of the sheath, or of the circle surrounding the nerve, may exist without hyperæmia of the proper nerve-tissue, and it has been supposed that fluid pressure in the intervaginal space may interpose an obstacle to the circulation in the vessels which pass through the sclerotic foramen, and may thus occasion dropsy of the termination of the nerve within the eye. Of the two foregoing conditions, either may undergo resolution harmlessly, or may produce such changes in or around the nerve as to occasion atrophy and loss of sight. Neither of them interferes with sight directly, because the circulation may be seriously disturbed by a degree of pressure which is insufficient to stop the conduction of impressions through the nerve-fibres. There is yet a third condition, properly called optic neuritis, or *neuritis descendens*, in which the capillary network of the nerve itself participates in changes propagated downwards, and in which impairment of vision holds a very early place among the symptoms.

1. *Perineuritis.*—The true perineuritis, in which the unchanged nerve-disc is surrounded by a zone of high vascularity, is only seen as a result of meningitis, which may be either tubercular or due to other causes. It was at one time hoped by Bouchut, by whom this especial phenomenon was first described, that perineuritis might serve as a diagnostic sign in cases of doubtful meningeal inflammation; but this expectation has not been realised. The perineuritis itself has only

been observed in cases the character of which was scarcely doubtful, and which, in most instances, have terminated fatally. Very probably, however, it would be found, if looked for, in those cases of exanthematous and other fevers which are attended by cerebral symptoms, followed after recovery by impairment of vision. In these we eventually find, as a rule, a partial nerve-atrophy, which does not lead on to complete blindness, but which does not appear to be susceptible of improvement; and this partial atrophy may no doubt be due to the pressure of perineural exudation during its contracting stage.

TREATMENT.—The treatment of perineuritis must generally be that of the affection in which it has its origin; but, in any fever in which this symptom had been detected, it would be a question whether mercury should not be cautiously administered for a considerable time after convalescence, in order to promote the absorption of any effused lymph by which the optic-nerve entrance might be constricted.

2. *Choked Disc.*—SYNON.: Dropsy of the Optic-Nerve Entrance.—This is a condition chiefly seen in connexion with intracranial tumours, whether syphilitic, tubercular, or of some other kind; and it almost invariably affects both eyes. It was formerly supposed to be due to the pressure of fluid driven down the intervaginal space around the nerve, and so constricting the latter at the terminal *cul-de-sac* as to impede the outflow of venous blood. This hypothesis is not now universally accepted, but the condition visible with the ophthalmoscope is one of distension and tortuosity of the retinal veins; arrest of the capillary circulation; impediment to the arterial inflow; dropsical effusion into the disc-tissues; and, sometimes, secondary inflammatory changes, such as effusion and cell-proliferation, comparable to the erythema which occurs in the integument of a dropsical limb. All these changes may exist without impairment of vision, because they neither affect the perceptive layer of the retina, nor arrest the conduction through the nerve-fibres. At a later period, however, when any plastic elements in the exudation begin to undergo contraction, the interference with the circulation becomes more complete, the nerve-fibres themselves become compressed, and then failure of sight commonly occurs. At the same period, the nerve passes into a state of atrophy from the interference with its circulation; and these cases of nerve-atrophy were once sources of great perplexity to surgeons, and were referred to alcohol, tobacco, and to other causes which probably had very little to do with them. In consequence of the sight not being affected during the preliminary stage, the occurrence of this stage was for a long time absolutely overlooked, and was only discovered when physicians began to use the ophthalmoscope, as an ordinary instrument of diagnosis, in all cases of cerebral affection. It was then soon established, notably by the labours of Drs. Hughlings Jackson, Buzzard, and Clifford-Allbutt, that the atrophy had been preceded by swelling of the disc and by obstruction of its circulation; and it was shown before long that the cases of atrophy which had this history were recognisable, after the swelling had passed away, by the tortuosity of the retinal veins which was left behind, and by the way in which these veins were lifted into bold curves at the margin of the disc; this alteration of their original course having been due to the swelling, and remaining after the swelling had subsided. The contraction of the effusion, and the consequent atrophy of the nerve-fibres and closure of the capillary vessels, would be likely to occur earlier in some parts of the disc than in others; and hence, at the time when commencing failure of sight first induced the patient to seek advice on account of it, the disc was commonly seen to be invaded by sectors of whiteness, but to retain its vascularity, or perhaps more than its normal vascularity, in other parts; while, at the same time, the sight was first lost in those regions of the retina the fibres from which were first compressed. Hence it follows that a partial invasion of the disc by atrophic changes, and a partial invasion of the field of vision by blind portions, are among the earliest symptoms in cases of the class under consideration; and these symptoms were at one time referred rather to the nervous centres than to the retina or the disc itself, to changes in which they are now attributed. A not uncommon clinical history in such cases is that there has been constitutional syphilis, imperfectly treated, and ultimately producing headache or other cerebral symptoms, which have probably called for the administration of iodide of potassium and have been relieved by it. Some weeks afterwards there is for the first time a complaint of failing sight; and then the ophthalmoscope reveals that the discs are passing into atrophy, that the retinal veins are lifted into prominent curves at the disc-margins, and that their further course over the retina is generally serpentine. In many cases, the recovery of the patient, as far as general health is concerned, leaves the precise character of the intracranial mischief doubtful; but, in fatal cases, a tumour is the morbid condition most frequently discovered. *See* OPHTHALMOSCOPE IN MEDICINE.

When the merely passive dropsical effusion into the disc becomes complicated with inflammatory changes, as results of the disturbance of the tissues, the sight begins to fail before atrophic changes become manifest; and such cases are very difficult to distinguish from those in which there is *primary or descending neuritis.* The blood-supply of the optic nerve being derived from the anterior cerebral artery, we may reasonably expect to find capillary engorgement of the nerve-substance of the disc in connexion with arterial hyperæmia of the brain ; and this capillary engorgement may pass into inflammation, either of local origin or by transmission downwards from above. In any case, if the first changes in the disc are of the character of neuritis rather than of obstruction, we see capillary or arterial hyperæmia of the nerve-substance rather than venous congestion ; and effusion of plastic material upon the disc itself, with comparatively little prominence or disc-swelling, and with comparatively little extension over the disc-margins upon the surrounding retina. At the same time, even in the early stage of the affection, we find great impairment of sight, the conducting power of the nerve-fibres being seriously injured. Such cases are frequently syphilitic, and, unless the absorption of the effusion should be quickly brought about by treatment, its contraction, like that of the effusion of obstruction, soon occasions atrophic changes. In these cases, however, the swelling having been absent or inconsiderable, the vessels do not show that elevation into bold curves at the disc-margin which has already been described ; and the contraction being interstitial in the nerve-substance, and from the first affecting veins and arteries in an equal degree, the arterial inflow is diminished *pari passu* with the diminution of the vein-channels, and the latter vessels are seldom distended in such a manner as to render them distinctly varicose or tortuous. The ultimate result is a white disc, on which the arteries and veins are dwindled to threads, or at least greatly reduced from their normal calibre.

We may therefore have three conditions which in their typical forms are tolerably distinct, but which are prone to run into one another by almost imperceptible gradations, and which may all lead on to atrophy and complete blindness: namely, perineuritis, neuritis, and choked disc. The liability to the last-mentioned condition should be carefully remembered by physicians, and should lead to careful ophthalmoscopic examination in all cases of obstinate headache or other cerebral symptoms of obscure origin, more especially in a patient with a syphilitic history.

Treatment.—It is manifest that the best hope of preventing ultimate blindness in persons in whom choked disc has occurred will be secured by the administration of medicines calculated to assist the absorption of the effusion, and by continuing these medicines, with comparatively small reference to the general symptoms, until the discs have cleared. The writer has seen such clearing occur, without loss of sight, in circumstances which rendered it almost certain that neglect of the disc-effusions would have been followed by blindness at no distant date. The same general rule will apply, of course, to the more directly inflammatory effusions of neuritis or perineuritis ; and, when we find any one of the three conditions passing into atrophy, or when we find commencing atrophy in discs which show traces of past effusion, the principle of treatment is to endeavour to promote the absorption of any contracting material which may be the physical cause of the atrophy; and then, when this has been done, to seek to stimulate the nutrition of the nerve-fibres, and to assist them to recover from the shock which they have sustained. The mode of fulfilment of the first indication must depend mainly upon whether there is a history of syphilis, and, if so, upon the manner in which it has been treated. In the numerous cases in which a short course of mercury has been administered, enough to alleviate secondary symptoms, but wholly insufficient to eradicate the disease, it will generally be desirable to give iodide of potassium in full doses for a time, and to follow this by the prolonged administration of the perchloride of mercury, in the hope of really curing the patient. There are, in the writer's opinion, few things better worth remembering in therapeutics than that the iodide, immeasurably the most valuable drug which we possess as a remedy for a late syphilitic symptom, is, none the less, almost useless as a remedy for constitutional syphilis. It will remove the present symptom, speedily and often completely ; but it can scarcely be said to have any tendency to prevent the recurrence of syphilitic symptoms at a future time, in the same or in some different form. For this purpose, the only trustworthy agent is mercury; and therefore, while the administration of the iodide for a sufficient time, and in sufficient quantities to test its power of doing good, will be enough in the cases in which syphilis is neither known nor suspected, the iodide must be followed by mercury whenever a syphilitic history of the affection is either clear or highly probable. The second indication, to stimulate the nutrition of the nerve-fibres, is usually best accomplished by strychnine, given at such intervals and in such doses as to produce evidence of its constitutional effect before its administration is abandoned. It may perhaps be most effectually given by hypodermic injection ; but this is a point which must be settled in accordance with the circumstances of the case in each individual instance. During the last two or three years, in cases of great disc swelling with impairment or loss of sight, the writer has on four occasions incised the sheath of the optic nerve behind the eye, so as to give exit to any accumulation of fluid in the intervaginal space, or to release an inflamed nerve from the pressure of its unyielding covering. The results have been generally satisfactory ; and in one of the patients, who had been totally blind for several days, vision was completely restored.

3. *Toxic Amblyopia. Toxic Central Neuritis.*—Much attention has been bestowed of late years upon a form of gradual failure of vision which first affects chiefly the central portions of the retinæ, and which appears to depend upon a chronic neuritis attacking originally the portion of the optic nerve-trunk which contains the fibres destined for the region of the macula lutea. This affection has often been connected with the excessive use of the stronger forms of tobacco, as well as with the abuse of ardent spirits, or with both these conditions in combination. It is characterised by impairment of sight, and also of colour-sense, the impairment being at first limited to the central portion of the field, and the colour-sense often becoming changed before form-vision is very noticeably affected. It may extend, if neglected, over the whole of the nerve-fibres, and may ultimately lead to practical, but seldom to absolute, blindness, perception of light and of large objects being often retained. In order to test for central loss of colour-sense, it is necessary to be provided with small red and green objects which may be moved in succession over various parts of the field, and which, in typical cases, will appear much less bright in the centre than when they are held a little to one side of the direct line of vision.

Treatment.—This consists, firstly, in the abandonment of tobacco and alcohol; secondarily, in endeavours to improve the general health; thirdly, in the use of medicines, such as iodide of potassium and mercury, by which chronic inflammatory conditions are likely to be controlled; and, lastly, in stimulation of the weakened nerves by the careful employment of strychnine. A very careful prognosis should be given in the first instance; but, if improvement once commences, the case will usually terminate in recovery.

4. *Sclerosis of the Optic Nerve.*—Besides the consecutive forms of atrophy above enumerated, there is yet another of common occurrence, which is either a primary sclerosis of the optic nerve, or a sclerosis secondary to a similar affection of other parts of the nervous centres. This form of atrophy is not preceded by effusion, nor is it attended by any marked decrease in the calibre of the central vessels of the retina, even when the capillary circulation of the disc has almost wholly disappeared. It is often seen in connexion with disease of the spinal cord, as in locomotor ataxy; and also occurs in apparently healthy people, seemingly as a purely local affection.

Sclerosis is easily distinguished from the atrophies consecutive to effusion, whether active or passive, by the circumstance that the effusion, as it undergoes contraction, tends to render the nerve-tissues opaque as well as to bleach them, and thus leaves a disc-surface of an almost ivory whiteness and of uniform colour. In sclerosis, on the other hand, the nerve-tissue disappears to a great extent, and reveals the mottled surface, often of a bluish-white tint, of the lamina cribrosa. When this is plainly seen, and when, at the same time, the vessels are neither much diminished in calibre nor altered in their normal curvatures, sclerosis may be assumed to exist; and this form of atrophy may also be distinguished from that which is produced by the most chronic forms of glaucoma, by the circumstance that in the latter the vessels bend into the excavated disc at its margin, while in the former they pass over the margin in straight lines or nearly so. Chronic glaucoma would also usually be distinguished by the character of the failure of sight, which would be marked by the ordinary contraction of the field of vision, even when central vision was only a little impaired; and also by the gradual hardening of the eyeball, which would be present in glaucoma and absent in nerve-sclerosis. Still it cannot be denied that this particular diagnosis is not without its difficulties, and that in certain cases it has given rise to differences of opinion between men of large experience on all sides of the question at issue.

The diagnosis is important as well as difficult, since the mischief of glaucoma may admit of arrest by iridectomy or sclerotomy; so that to mistake chronic glaucoma for atrophy, and to neglect operation, may be to condemn the patient to unnecessary blindness. The opposite error can at least do no harm; and therefore, whenever a doubt really exists upon the point, the most proper course is to give the benefit of that doubt to the patient, and to advise the performance of an operation which cannot injure, and which may relieve him. The atrophy of sclerosis scarcely admits of treatment, but it may perhaps sometimes be delayed, or even prevented from becoming complete, by the administration of full doses of strychnine and iron.

5. *Atrophy from other causes.*—Besides the foregoing forms of atrophy, there is a variety which appears to be associated with chronic lead-poisoning, and in which the discs may acquire a peculiar grey or bluish tint; and the optic nerves may also undergo secondary wasting in consequence of other conditions presently to be mentioned, such as obstruction of the central artery by an embolus, or the long continuance of pigmentary retinitis.

6. *Retinal Hæmorrhage.*—The chief disorders of the retinal circulation displayed by the ophthalmoscope are hæmorrhages, which may be attended by very different circumstances, and may present widely different characters.

a. Single.—When blood proceeds from one of the larger veins of the retina, which yield a considerable quantity, and which are situated immediately underneath the limiting membrane, the hæmorrhage usually spreads out over the fundus as a red patch of uniform colour and aspect, and vision is suddenly, and sometimes almost totally, obscured. The writer has seen such bleeding occur from the yielding of a vessel during parturition; but this accident is extremely rare, and the large hæmorrhages in question are certainly more common in women at the period of cessation of the menstrual function than in any other circumstances. At this time, and when the health is not seriously affected, a favourable prognosis may be given with some confidence; for the blood will before long be absorbed, and restoration of vision, at least in a considerable degree, may be expected. The writer has once seen complete restoration to the normal standard, but this is an exceptional occurrence.

Treatment.—The only treatment necessary is to pay attention to the requirements of the general health; and to prescribe such diet, medicines, regimen, and habits as may tend to calm and equalise the circulation, and to prevent local congestions. The occurrence of sudden loss of sight in one eye will justify the suspicion of hæmorrhage; but the suspicion can only be converted into certainty by the ophthalmoscope.

b. *Multiple.*—A form of venous hæmorrhage which at first seems less formidable, because it is attended by a smaller degree of immediate interference with sight, but which calls for a less favourable prognosis, is that in which the hæmorrhages are multiple, often singly of small size, and scattered over the whole fundus of the eye. The appearances which they present differ, apparently in accordance with their precise position in the retina. If they proceed from vessels which are superficial, the blood is spread out, as in the last variety, in round or oval patches beneath the limiting membrane; but if the vessels lie a little deeper, and are fairly engaged in the fibre-layer, the blood will separate the fibres and find its way between them, forming flame-shaped or brush-like patches, which are often very numerous. Such multiple hæmorrhages are very slowly absorbed, and have a tendency to recur; so that they must always be regarded as placing the sight in serious jeopardy. They are often monocular, and they do not point to any definite disturbance of the general health. The only endeavour so to connect them with which the writer is acquainted was made by Mr. Hutchinson, who described some cases of flame-shaped hæmorrhage in persons all of whom he said were 'gouty'; but it will certainly be the experience of most practitioners that flame-shaped hæmorrhages occur in many patients who are not 'gouty' in the ordinary sense, and that they do not occur in vast numbers of those about the reality of whose gout there can be no question. The presence of multiple hæmorrhages is sometimes attended by a considerable degree of irritation, or even inflammation, in the tissues among which the blood has been effused; and this condition, in which the retina between the blood-spots may become opalescent or turbid, has been described as a form of retinitis—*retinitis apoplectica.* The element of inflammation, in such instances, is probably merely a reaction consequent upon the injury inflicted upon the tissues, and it cannot be inferred that the bleeding is itself the result of any inflammatory process.

Treatment.—In this, as in the former variety, there is no special indication for treatment, which must be confined to the correction of any manifest disorder of the general health, followed, in most instances, by the administration of iodides or bromides, as medicines calculated to assist in the absorption and removal of the effused products. Any indication of a general hæmorrhagic tendency, or of a state allied to purpura or scurvy, would require, of course, full consideration and appropriate treatment. The extent of the ultimate injury to sight will usually depend upon the extent to which the perceptive elements of the retina have been compressed or disorganised, either by the bleeding itself, or by other changes consecutive to it.

c. *Arterial.*—Hæmorrhages which are distinctly arterial are not uncommon in the fundus of the eye, and can generally be distinguished without difficulty from the venous variety, not only by the colour of the effused blood, but also by the situation of the blood-patch, and by its manifest relations to a small arterial branch, which may often be seen to have dwindled or closed beyond the point at which it has given way. Arterial hæmorrhages are mostly multiple, but of small individual extent; and, when not in the immediate neighbourhood of the optic disc, are most commonly seen near the outer limits of the ophthalmoscopic field of view. They are generally attended by sufficient impairment of vision to occasion complaint, and thus to lead to their detection; but they seldom occasion blindness. They call for an examination of the urine for albumen, and, failing any evidence of renal mischief, they are chiefly important as indications of a weakened and brittle state of the arterioles, likely to lead to intracranial hæmorrhage.

Treatment.—Arterial hæmorrhages into the retina point to the necessity of diminishing, as much as may be possible, the strain upon the arterial coats, by such means as the avoidance of muscular exertion or mental emotion, and by seeking to diminish the quantity of the circulating blood by a diminution in the quantity of fluid ingested. Even when all precautions have been taken, arterial retinal hæmorrhages are common forerunners of apoplexy.

7. *Embolism of the Central Artery of the Retina.*—Embolism of the central artery of the retina, or of one of its branches, is a condition of not infrequent occurrence.

Symptoms.—When sudden blindness of one eye occurs in a person who is the subject of valvular disease of the heart, the diagnosis can scarcely be doubtful; but the ophthalmoscopic appearances will suffice to remove doubt if it should exist. The immediate effect of the sudden arrest of the arterial circulation of the retina is to render that membrane opaque and of a milky whiteness, except over the macula lutea, where the absence of connective tissue prevents any such change from being produced. Here, and here only, the original transparency is retained, and the colour of the choroid is still visible, with the result that the macula appears as a cherry-red spot in the midst of a white surface. When not concealed by the opacity, the larger veins of the retina are diminished in calibre and contents, and their blood is sometimes broken up into detached portions separated by interspaces. The arteries are empty, and are either invisible or traceable as white lines of fibrous tissue in the general milkiness of the fundus. The disc is usually bleached, but it will sometimes happen that its condition may be temporarily obscured by arterial hæmorrhage, occurring from some twig given off just below the seat of the embolus, and entering the eye independently.

The driving home of the embolus will throw upon such a twig the whole force of the circulatory *vis a tergo*, and may thus rupture it—an occurrence of which the writer has seen several examples. The blood so effused is usually absorbed in a very few days, revealing the white disc and the collapsed arteries, and removing any uncertainty which might have existed with regard to the diagnosis. The opalescence of the retina also disappears before long, and then only the secondary nerve-atrophy and the disappearance of the arteries remain to disclose the nature of the original affection. Embolism seems to be a perfectly hopeless condition, because there is no anastomosis between the retinal and other vessels of a sufficient extent to maintain a collateral circulation. The writer has met with one instance in which only a sector of the field was affected, and with one in which embolism of a very small branch produced loss of sight over all the peripheral parts of the field, leaving central vision almost intact; but such cases are among the curiosities of ophthalmology, and complete and permanent loss of sight of the affected eye is the result which must always be anticipated.

8. *Retinitis.*—Retinitis is commonly described as occurring in three chief forms—the *albuminuric*, the *syphilitic*, and the *pigmentary*; but the writer is inclined to believe that only the last of these three is a genuine retinitis, and that in the others the inflammation, if it should exist, is merely a secondary consequence of the irritation produced by the presence of adventitious deposits.

a. Albuminuric Retinitis.—In the so-called albuminuric retinitis, the sequence of events appears to lend support to the contention of the late Sir William Gull and Dr. Sutton, to the effect that the renal disease is not an original affection, but only a result of morbid or degenerative changes which are common to the whole of the small arteries of the body.

Symptoms.—In many cases of albuminuria, the sight is not affected from first to last, and the retinæ remain healthy. In some, the retinal changes precede the appearance of albumen in the urine; and, in the majority, the renal and retinal changes are coincident. The retinal changes are of two kinds: namely, arterial hæmorrhages, occurring in the fibre-layer, so that the blood-patches assume a fibrillated aspect with brush-like terminations; and the formation of white patches, either of cholesterine deposit or of fatty degeneration, or of both combined, scattered irregularly over the fundus, but often grouped into a stellate figure around the macula lutea, and into an irregular ring around the disc. To these appearances are added, in some cases, those of swelling of the disc-margins with effusion into the retinal fibre-layer; and, when the last-named appearances are presented, there is always a far greater deterioration of sight than when they are absent. It is a matter of daily occurrence that the existence of renal disease is not suspected until impairment of sight leads to an ophthalmoscopic examination, and this to the discovery of the retinal changes; and, in every hospital, cases which apply for relief to the ophthalmic department are constantly, on this ground, transferred to the physician.

Treatment.—The treatment of the renal maladies which produce albuminuria is in no way modified on account of the presence of a retinal complication; and the unfavourable prognosis which must generally be given as regards life throws into comparative insignificance the gradual failure of vision, which seldom proceeds to complete blindness.

b. Syphilitic Retinitis.—This is usually an incident of the most advanced stages of the disease, and is most frequently seen in persons who have been inadequately treated during the primary stage, but who have for some months or even for a year or two been free from symptoms.

Symptoms.—Dimness of sight is then complained of, and the retina is found to present scattered patches of very irregular outline, and of a filmy whitish aspect. Such patches may be more or less obscured by slight general turbidity of the retina itself, or of the vitreous body in its immediate vicinity, the latter condition being of itself almost conclusive of the nature of the malady.

TREATMENT.—The treatment must be greatly governed by the past history of the case, but may in most instances turn upon the use of iodide of potassium for the relief of the retinal troubles, followed by a sufficient course of mercury for the eradication of the syphilitic taint.

c. *Pigmentary Retinitis.*—This appears to be a true inflammation of the retina, differing from the foregoing affections in that it attacks the percipient elements, instead of the fibre-layer or the connective tissue of the membrane.

ÆTIOLOGY.—The subjects of pigmentary retinitis are of all ages, from nine or ten years to seventy; and, in some instances, the duration of the disease has been as much as twenty years, from the first appearance of the symptoms to their ultimate termination in blindness. As a rule, however, the patients are young adults, or persons not past middle age.

It is a remarkable feature of pigmentary retinitis that it almost invariably attacks more than one member of a family; and it has been said to be especially frequent in the offspring of marriages of consanguinity, but this statement is not borne out by English experience. During the last twenty years the writer has only met with one family in whom the malady had this history.

ANATOMICAL CHARACTERS.—From the extreme chronicity of its course, from its obstinacy, and from its peculiar anatomical distribution, pigmentary retinitis should probably be regarded, together with some forms of choroiditis, as having its analogies among some of the chronic diseases of the skin. It usually appears to commence in a narrow annulus near the equator of the eyeball, and gradually spreads inwards towards the optic disc; the tissues affected are the perceptive and pigmentary layers of the retina and the subjacent chorio-capillaris, which slowly become disorganised and matted together in one common degeneration. Coincidently with the progress of the disease, pigment is deposited in the parts affected, and in the retina superficial to them, in the form of irregular lines and striations, and especially along the course of the main arterial branches. As the annulus of disease gradually closes in upon the macula, the optic disc undergoes atrophy of a kind which gives it a peculiar tint of whiteness, very readily recognisable when it has once been noticed, and the central vessels, both veins and arteries, dwindle in size.

SYMPTOMS.—The subjective symptoms are as characteristic as the ophthalmoscopic appearances. Over the region actually invaded, the perceptive elements of the retina are destroyed, and the power to receive visual impressions is lost. The fibre-layer not being implicated, the conduction of impressions from parts of the retina more peripheral than the disease may remain unaffected; and hence we may have a blind zone surrounding the centre of the field of vision, and surrounded itself by a zone still more external, in which dim vision is preserved. But the salient symptoms are two—the gradual contraction of the field of vision due to the progressive encroachments of the disease; and night-blindness, due to the nerve-atrophy, which interferes with the conduction or perception of any but strong impressions. When these symptoms co-exist; when the field of vision is small and becoming gradually smaller; and when the patient, who can still see fairly in the daytime, can scarcely find his way about as dusk begins to fall, we may predict the ophthalmoscopic appearances with a very near approach to certainty. The optic disc will be unnaturally pale, and the fundus overstrewn, towards the periphery, with irregular black lines and stripes, of which it is quite possible that nono may be visible within that portion of the field of the ophthalmoscope which includes the disc.

DIAGNOSIS.—Pigmentary retinitis may possibly be mistaken for the most chronic form of glaucoma, on account of the contraction of the field of vision; but it may be distinguished by the absence of high tension, by the night-blindness, and by the pigmentation of the retina. It may also be mistaken for the atrophy of sclerosis, but only if the ophthalmoscopic examination is limited to the nerve-disc, to the exclusion of the surrounding parts of the fundus.

TREATMENT.—In the treatment of a disease so essentially chronic, it is difficult to arrive at any trustworthy evidence concerning the efficacy of a remedy, but the prolonged administration of iron, rather as a food than as a medicine, is at least of a certain degree of utility in arresting the progress of the malady. The preparation employed is probably not material, and some may be found to suit particular persons better than others; but the writer is accustomed to begin with the tincture of the perchloride, in doses of five minims, well diluted and given three times a day as part of a meal.

9. *Detachment of the Retina.*—SYNON.: Subretinal Dropsy.—This is a condition the causes of which have never been satisfactorily explained, but it has been attributed to the contraction of inflammatory effusions in the vitreous body, which have been supposed thus to exert traction on the retina.

The first symptom which attracts the attention of the patient is the loss of part, usually either the upper or the lower part, of the field of vision; and it is manifest that loss of the upper part of the field means detachment of the lower part of the retina, and *vice versâ.* Detachment is sometimes produced by a blow or injury, but more frequently it occurs without any assignable cause, either local or constitutional. One or both eyes may be affected.

The diagnosis of the disease is rendered easy by the ophthalmoscope, which exhibits the detached portion as a sort of floating prominence, projecting into the interior of the eyeball, generally bluish-white in colour, and crossed by the retinal blood-vessels.

The prognosis is very unfavourable in the majority of instances, and treatment is seldom effectual.

TREATMENT.—Cases have been recorded in which disappearance of the sub-retinal fluid, and restoration of vision, have followed prolonged confinement in the supine posture; and the occurrence of improvement after spontaneous rupture of the detached portion suggested to von Graefe the advisability of producing such a rupture by artificial means. Various operations have been undertaken for this purpose, and also for the evacuation of the sub-retinal fluid through a puncture in the outer tunics of the eye, and have in a few instances been partially successful; but the evidence in their favour is at present very feeble, and hardly establishes more than that attempts of such a nature may be made, if it is certain that the sight will be irretrievably lost in the absence of interference. The writer once obtained an excellent result by puncturing a detached retina in an eye from which cataract had been removed eleven years before; but the puncture was greatly facilitated, and its risks were in a corresponding degree diminished, by the absence of the lens. Two or three years later, however, the detachment returned and became complete. The tendency of detachment, especially in the upper portion of the retina, is to increase until the whole membrane is elevated from the choroid, and vision is entirely destroyed. It must be borne in mind that detachment may be simulated, or may even be caused, by the growth of intra-ocular tumours, sarcomatous or gliomatous, which may demand the early removal of the eyeball. Such cases would usually be distinguished from simple detachment by the increased hardness of the eyeball, which the morbid growth almost necessarily occasions, and which would be the more significant inasmuch as detachment alone is usually accompanied by diminished tension. It must nevertheless be remembered that normal tension does not absolutely preclude the presence of tumour; as there are well-authenticated cases in which the absorption of the ocular fluids has, for a time, precisely kept pace with the increase of the growth.

10. *Glioma.*—This name has been given by Virchow to a malignant growth which has its origin in the neuroglia, or connective tissue of the nervous system, and which was formerly described as encephaloid cancer. When originating in the retina, it early produces loss of sight, and presently shows through the pupil as a substance of a primrose-yellow colour, by which the still transparent lens is pressed forward towards the cornea. It is chiefly a disease of childhood, and has been seen by the writer as early as the fifth week of infant life. It is liable, by superficial observers, to be mistaken for congenital or infantile cataract, an error which must be carefully guarded against, because the early and entire removal of the eye, together with as much of the optic nerve as can be reached, furnishes the only hope of preserving the life of the patient. When the operation is performed sufficiently early, it has in a few instances been completely successful, cases having been recorded in which no recurrence of cancer has happened after the lapse of years. In the great majority, however, recurrence and death have terminated the history.

11. *Sarcoma.*—This differs from glioma in having its origin in the choroid, and in being of a darker colour, and sometimes pigmented or melanotic. It is at least equally malignant, produces similar symptoms, and requires the same treatment.

VIII. Diseases of the Choroid.

—Diseases of the choroid, recognisable by the ophthalmoscope, are almost limited to certain chronic forms of inflammation and of atrophy; for, in any acute choroiditis, there is always too much turbidity of the vitreous body to allow the state of the membrane to be seen.

Chronic Choroiditis.—The chronic forms of choroiditis are remarkable for leading to an undue formation, or to a great displacement, of the choroidal pigment; and to the ultimate complete wasting and disappearance of the portions of the choroid which are affected, so that over these portions there will ultimately be no choroid visible, and the ordinary red colour of the fundus will be replaced by the ivory whiteness of the inner surface of the sclerotic.

Chronic choroiditis may be divided into two chief varieties—the *disseminated* and the *diffused.* The *disseminated* occurs chiefly in children, and chiefly, perhaps exclusively, in those who are the subjects of inherited syphilis. It is seldom seen until its period of activity is passed. A child is brought on account of defective vision, which has probably existed from birth or from a time but little subsequent to it; and the ophthalmoscope displays a number of small white spots, with black borders, scattered irregularly over the fundus of the eye. The white spots are patches of choroidal atrophy, and the black borders are rings of increased pigment-formation, by which the spots of inflammation, which must have been comparable to little pimples, have been surrounded.

TREATMENT.—Such cases admit of no treatment, except in the rare instances in which some active mischief may be detected, in the shape of small patches or spots in which effusion has not yet passed into atrophy, and in which such an antisyphilitic treatment should be employed as the state of the patient may otherwise permit or indicate.

Diffused choroiditis is more frequently an affection of adult age; and, although very frequently syphilitic, is not invariably so. It differs from the foregoing chiefly in the absence of any defined shape or precise limitation of the parts affected. In the early stages the choroid is seen to be troubled by congestion or effusion, and these conditions pass gradually into abnormal pigmentation and atrophy. The course of the disease may be very chronic and irregular, and different stages of it may be seen at the same time in different parts of the same eye.

The prognosis may in general be moderately favourable; for, although the choroiditis destroys the portion of retina immediately in front of it, its extension is very capricious, and it may often be arrested in time to leave large portions of the eye, and especially the central portions, unhurt. When it occurs in the vicinity of the macula lutea, so as to imperil central vision, it is much more formidable than when confined to the more peripheral parts of the choroidal membrane.

TREATMENT.—Whenever there is a history of syphilis, this must be taken as the clue to treatment; and, if no syphilis can be discovered, the chief reliance must be placed upon rest of the eyes, occasional depletion from the temples by Heurteloup's leech, counter-irritation by blisters or setons, and such internal medication as the general state of the patient may suggest.

IX. Diseases of the Vitreous Body. Diseases of the vitreous body are as yet very imperfectly understood, and we know little more concerning them than that this substance is liable to become turbid in certain forms of acute general inflammation of the eye; and that it is sometimes rendered turbid, without inflammation, by the presence of floating films which may be readily seen by the ophthalmoscope, and which may be so numerous as to form a serious impediment to vision.

1. *Turbidity.*—Turbidity of the vitreous is very common in syphilitic cases; but the films referred to are seen when no syphilis can be suspected. Their number, and their free movements, show that the vitreous must in great measure have lost its natural semi-solid consistence, and have become fluid; but little or nothing is known of their actual pathology.

TREATMENT.—The most effectual treatment for flocculi in the vitreous is usually diaphoresis by the subcutaneous injection of from two to four minims of a 10 per cent. solution of hydrochlorate of pilocarpine, which may be repeated on alternate days. Local counter-irritation with iodine may also be practised; and iodide of potassium may be given internally in such doses as circumstances will allow.

2. *Muscæ Volitantes.*—A phenomenon referred to the vitreous body is the appearance of the moving particles, or strings of beaded filaments, which are commonly called *muscæ volitantes.* True muscæ are known by the negative character that the particles which produce them cannot be seen by the ophthalmoscope; and by the positive character that they never so intervene between the eye and an object, however small, as to exclude the latter from view. They are seen most readily against a white field, as a white wall or a white cloud, or in the illuminated field of a microscope when there is no object in view; and they float about with uncertain movements, but always a little out of the direct line of sight. They are occasioned by the filamentous framework of the vitreous body, and by the cell-nuclei or other irregularities upon the filaments. These bodies, without being opaque, yet differ in the precise degree of their transparency from the fluid which surrounds them; and hence they cast upon the retina shadows, which are then mentally projected outwards into space as floating objects. The projected shadows appear, of course, enormously larger than the microscopic specks which produce them, and the latter are wholly unimportant and of no morbid signification. Muscæ may be discovered by any person by the simple expedient of looking through a very fine perforation in a metal disc at a bright surface; and they are more conspicuous to some persons than to others, on account of the varying differences which may exist in different eyes or in the same eyes at different times or under different conditions, between the index of refraction of the filaments and nuclei and that of the surrounding fluid. Moreover, by the operation of an obvious physical law, the more distant the particle from the retina, the larger will be its shadow upon that membrane, and the larger and more conspicuous will it appear. For this reason, and on account of the elongation of the myopic eyeball, muscæ are usually more complained of by the short-sighted than by others. They are often sources of great uneasiness to patients; but, when once their true character is known, they may be entirely disregarded as harmless appearances, the natural results of physiological structure. It is often important that the physician should be able to make their nature understood, in order that he may dissipate, once for all, the unfounded apprehensions which may be occasioned by their presence.

X. Diseases of the Eyelids.—The external surfaces of the eyelids, as parts of the common integument, are liable to all its diseases, and may thus participate in erysipelatous inflammation, in eruptions, and in the results of injury, besides becoming the seats of nævi, moles, warts, and other growths. Among the diseases special to the formation of the eyelids, the most important are the variations of shape to which they are subject, generally from the contraction of inflammatory exudations, but sometimes from perverted muscular action; the cystic tumours which are produced by obstruction of the orifices of Meibomian glands; the inflammation of the follicles of the eyelashes, or blepharitis; spasmodic closure, from abnormal muscular contraction; and either patency or passive closure, from paralysis. Many of these affections are distinctly surgical, and others are only parts or symptoms of more general disorders.

1. *Blepharitis.*—Blepharitis, or inflammation of the follicles of the eyelashes, has received a great variety of names from different writers, and is frequently known as *tinea tarsi*, or, in its more advanced stage, as *lippitudo*. The disease consists essentially of an inflammation of the lining membrane of a hair-follicle from which an eyelash springs.

Symptoms.—The first manifest symptoms are a small swelling close to the edge of the eyelid, generally of the upper lid; and the formation of a crust around the bases of the cilia which proceed from the swollen part. The swelling does not extend farther up the lid than to the breadth of about a line, but it soon spreads along the border until the whole length is involved, and it usually spreads also to the lower lid, manifestly in consequence of the contagious character of the discharge. If the crust is removed, and if the part from which it springs is magnified and carefully examined, it will be seen that the mouths of the follicles are somewhat open, no longer fitting closely to the issuing hairs; and, in a few moments, a clear fluid will be seen to exude, and speedily to dry into a crust or film, which covers the opening as if with a varnish. Many of the hairs in the affected follicles are loosened, and fall readily, or may be removed painlessly by slight traction. If the case is neglected, the follicles are before long destroyed as hair-bearing organs, so that the lost cilia are no longer reproduced; and, at the same time, the exudation which constitutes the subcutaneous swelling of the lid-margin begins to undergo contraction, and in this way gradually everts the cartilage of the lid. The edges of the lids become red, swollen, and unsightly; the lachrymal puncta are displaced outwards in such a manner that they can no longer take up the tears; the eyes have lost the protection of the lashes, and are exposed to numerous sources of irritation from atmospheric particles and other causes, so as to be especially prone to conjunctival and corneal inflammations; and these results are almost incurable. It is therefore very important that blepharitis should be effectually treated in its early stages, when, if only due care be taken in the selection and use of remedies, it is an exceedingly trivial affection.

Treatment.—The most essential part of the treatment is to remember that the secretion which forms the crust is of such a nature that it is not very easy of removal, and that, while it remains *in situ*, no remedies, however judiciously chosen, can obtain access to the parts really affected by the disease. The crust is composed partly of the already mentioned secretion from the inflamed surfaces, partly of the greasy secretion of the Meibomian glands; and it is the admixture of the latter which renders the crusts difficult of removal by water alone. A solution of bicarbonate of sodium, of the strength of five grains to the ounce of warm water, will remove them readily; and this solution should be applied in such a manner as to soak into the crusts and loosen them thoroughly before any attempt is made to detach them. As soon as they are detached, the surface beneath should be gently dried with a morsel of absorbent rag, and then an astringent should be applied immediately, so that it may find its way down into the depths of the hair-follicles, and may thus reach the seat of the malady. The best astringent is generally the ointment of the precipitated yellow oxide of mercury, or Pagenstecher's ointment, already recommended for the cure of ulcers of the cornea; and this may be applied to the affected part by the tip of a finger. If amendment does not speedily follow, it may be suspected that the crusts have been imperfectly removed, or the applications imperfectly made, and it will be well for the practitioner personally to superintend the process. When this has been done, if the affection continues obstinate, some other astringent should be tried, and the nitrate of silver is among the best for this purpose. Amendment of the lid-margin may generally be quickly produced; but the disease will for a long time lurk in the depths of the follicles, and the treatment must be continued until all subcutaneous swelling has disappeared from the lid-margins. Unless this be done, speedy relapse is inevitable, the inflammation soon creeping out of the follicles again and recovering the ground of which it had been deprived. Such a result is constantly seen in hospital practice, in spite of all efforts to guard against it, and, in prescribing for blepharitis, it is always desirable to warn parents of the perseverance which will be required, and of the great importance of obtaining a radical cure. There can be no doubt that blepharitis is exceedingly contagious through the medium of its secretion, conveyed upon sponges, towels, or fingers, and this should be fully recognised whenever it attacks children who are attending a school. The name 'tinea tarsi' may perhaps be taken as the expression of a belief that the disease is allied to tinea tonsurans, and that it is produced by the growth of a parasitic fungus. The writer does not at present see any sufficient ground for the adoption of this opinion.

2. *Entropium and Ectropium.*—Incurvation and excurvation of the eyelids may be looked upon as purely surgical maladies. The former exposes the eyes to injury from the irritation of inturned eyelashes (*trichiasis*); the latter from foreign bodies of various kinds.

TREATMENT.—The remedy for both, when any is practicable, must usually be sought in a surgical operation. An exception depends upon the fact that ectropium is sometimes produced by paralysis of the facial nerve, which renders the orbicularis muscle flaccid and powerless, and permits the lower lid to fall downwards under the influence of gravity. The cure of the general nerve-affection may restore the power of the muscle, and may in time lead to complete recovery of the natural position of the lid. In such cases, even if electricity does not form part of the general treatment of the paralysis, it may often be applied with benefit to the orbicularis.

3. *Blepharospasmus.*—This term is generally employed to denote an intermittent closure of the eyelids by an involuntary action of the orbicularis, in response to some concealed source of irritation; and is thus broadly distinguished from the spasm which accompanies photophobia.

SYMPTOMS.—The spasm is most liable to occur in circumstances of mental excitement. Thus, in one of the writer's patients, who was a skilful cook, the eyes were apt to close, and to remain closed for some minutes, at the critical period of an important dish. Another patient was a schoolmistress, and the spasm would interrupt the progress of a lesson to a class, being doubtless to some extent excited by the dread of its occurrence. In a third case, the patient being a gentleman habituated to riding and driving, the spasm would be excited by physical irritants, such as wind or dust, and, almost certainly, by circumstances which required the eyes to be wide open as a condition of safe guidance. The motor nerves appear, as a rule, to be merely the passive conductors of a reflected impulse, and the trouble seems usually to be dependent upon a morbid condition of the fifth, or upon a source of irritation in some peripheral part from which a twig of the fifth passes to the centre.

TREATMENT.—In the treatment of such cases, it is sometimes possible to find the twig which conveys the impression; that is to say, to discover a point where pressure, sufficiently firm to arrest conduction, will at once relax the spasm. Such points should be looked for at the supra-orbital notch, over the malar bone, and in any other situation suggested by special circumstances; and, if a point at which pressure will arrest the spasm is discovered, we learn at once by what branch of the fifth, and therefore approximately from what region, the irritation is conveyed, and where its source is to be sought for. If nothing can be discovered by careful examination, decayed teeth, accumulations of cerumen in the ears, and conjunctival granulations are possible conditions which should be looked for, and which should receive attention if they are found. When all other treatment has failed, the spasm has sometimes been stopped by subcutaneous section of a sensory nerve; and this may always be practised hopefully if the spasm can be arrested by pressure on some definite spot, which must then serve for the guidance of the knife. If no such spot can be found, section of the supra-orbital nerve, and next of the subcutaneous malar, may be attempted; since neither of these is sufficiently important for its temporary disablement to be set against even the possibility of relief from a very distressing affection. In some cases, however, it would appear that the mischief must be central, and that no section of an afferent nerve can be useful. The division of the motor nerves of the orbicular muscles, if it could be successfully accomplished, would produce a paralysis even more injurious than the spasm; and the cases in which the latter is due to central irritation or other trouble, unless they can be relieved by medicine, and by the rectification of whatever may be manifestly wrong in the condition of the patient, offer very small hope of improvement. *See* FACIAL SPASM.

4. *Ptosis.*—Ptosis is a condition of permanent passive closure of an upper eyelid as a consequence of paralysis of its levator muscle, or it may happen in consequence of this muscle having been torn from its attachment to the tarsal cartilage, so that it can no longer modify the position of the lid.

SYMPTOMS.—Paralytic ptosis may be either partial or complete, according to the degree of the nerve-affection; and as the levator palpebræ is supplied by the third nerve, which supplies also the superior, the internal, and the inferior rectus, as well as the inferior oblique, the sphincter pupillæ, and the ciliary muscle, ptosis is usually accompanied by paralysis of one or more of these muscles. When they are all affected, the eyeball is turned outwards by the action of the external rectus, and is immovable in other directions excepting feebly by the superior oblique. The pupil is dilated, and the power of adjusting the eye for near vision is impaired or lost, although, when the lid is raised, near objects can still be distinctly seen by the aid of a convex lens. When all the muscles supplied by the third nerve are affected, the inference is that the cause of paralysis is acting upon the common trunk of the nerve; and such a cause is not infrequently the presence of periosteal swelling at the sphenoidal fissure. If only some of the muscles are affected, the inference is that the cause of the paralysis is either limited to the central nuclei of origin of certain filaments, or else that it is situated anteriorly to the division of the main trunk into the branches which proceed to different parts; and it is conceivable that the limitations of the paralysis may point, with tolerable certainty, to the precise locality of the disorder.

The causes of ptosis, as of other paralytic affections of single cranial nerves, apart from injuries and the pressure of morbid growths, may almost be reduced to syphilis and to impaired nutrition of the centres, the latter usually connected with hard mental work and worry. In every case, evidence of syphilis should be carefully sought for; and, if found, should determine the nature of the treatment, as it will also of the prognosis, which, in such instances, may be generally favourable. In cases of the second class, where there is no evidence of syphilis, and where the symptoms point to general impairment of nervous energy, the administration of iodide of potassium, in combination with tonics, will sometimes be useful; but the main reliance must be placed upon rest, good living, and external surroundings favourable to the restoration of health.

5. *Diplopia.*—Double vision, although it has no proper relation to the subjects treated of in the present section, is yet so far allied to ptosis that, when occurring suddenly, it is almost always an effect of paralysis or of paresis either of the sixth nerve of one eye, supplying its external rectus, or of the branch of the third which supplies its internal rectus. In the former case the affected eye will deviate inwards, and will have limited range of movement towards the outer canthus; while in the latter case these conditions will be reversed.

As regards the causes and treatment of these limited forms of paralysis, there is nothing to add to what has already been stated about ptosis. It is sometimes desirable, while the diplopia continues, to exclude the deviating eye from vision by a shade, an opaque spectacle-glass, or other suitable contrivance, on account of the vertigo and uncertainty of gait which may be occasioned by the double images.

See also EXOPHTHALMIC GOÎTRE; LACRYMAL APPARATUS, Diseases of; LAGOPHTHALMOS; ORBIT, Diseases of; STRABISMUS; STYE; and VISION, Disorders of.

R. BRUDENELL CARTER.

F

FACHINGEN, in Nassau, Prussia. Acidulous gaseous waters.—*See* MINERAL WATERS.

FACIAL PARALYSIS. — SYNON.: Paralysis of the Portio dura; Bell's Paralysis.

DEFINITION.—Paralysis of the muscles of the face, due to disease or injury of the nucleus or fibres of the seventh nerve (the portio dura of the seventh pair, according to the older nomenclature).

Above the nucleus, the motor path for the face decussates, and joins that from the arm and leg; damage, therefore, in the pons (above the crossing), in the crus, internal capsule, or hemispheres, may produce facial paralysis, but does so usually as a part of hemiplegia. This paralysis, which is on the same side as that in the limbs, is partial only, affecting chiefly the muscles of especial unilateral use (as the zygomatici); and very little those of solely bilateral use, in the upper part of the face—*e.g.* the frontales. In this article paralysis from damage to the fibres or nucleus of the nerve itself will alone be considered.

ÆTIOLOGY.—(1) The most common causes of facial palsy are unilateral, and damage the nerve as it passes through the narrow canal in the temporal bone. There, the slightest inflammatory effusion will cause pressure on the nerve. Such neuritis may be due to exposure to cold (and is often then called 'rheumatic'); to contiguous bone-disease, as caries; and sometimes to syphilis. Hæmorrhage into the sheath may also compress the nerve. Cold is the most common cause of palsy, but the exposure is often forgotten; it has been supposed to act by paralysing the peripheral nerve-twigs, but this is never the case in one-sided paralysis; in all cases lasting more than a few days, evidence of changed nutrition may be detected in the nerve-trunk as it emerges from the stylomastoid foramen. External cellulitis may extend into the canal. Tumours of the bone and fracture of the base may also damage the nerve as it passes through the bone. (2) Injury to the nerve outside the skull by blows, pressure by forceps in instrumental delivery, incised wounds—accidental or surgical, or parotid and other tumours, are occasional causes. (3) Within the skull the nerve may be damaged by meningitis, acute or chronic, and especially by syphilitic inflammation, or by pressure of neighbouring growths. The radicular fibres within the pons, or the nucleus beneath the fourth ventricle, may be damaged by hæmorrhage, softening, or by tumours involving that part.

Double facial paralysis is very rare, and is due to damage to both nerves at the base of the brain from meningitis or symmetrical syphilitic disease; to symmetrical otitis; or to an affection of the nuclei by disease of the pons, or to loss of function of the nerve-fibres in various forms of peripheral neuritis. It is probably by the latter agency that double facial paralysis sometimes results from toxic blood states. Syphilis and diphtheria are the most common antecedents of double facial palsy not due to demonstrable injury to the nerves. Disease of the nuclei affects both sides most frequently when it is degenerative in nature; it is then commonly partial, involving especially the lip muscles in labio-glossal paralysis, or the orbicularis palpebrarum in rare cases of nuclear ophthalmoplegia. Lastly, it may be mentioned that the facial muscles (generally those in and about the lips—rarely all) are occasionally involved in idiopathic muscular atrophy, and an affection of the nerves may be thus simulated.

Symptoms.—The onset of facial paralysis is usually rapid, when due to its common causes, including neuritis within the canal. It occupies from a few hours to three or four days in its development. It is found, for instance, one morning, in drinking, that the fluids run out of the side of the mouth; the face is noticed to be a little unsymmetrical; at night the eye cannot be completely closed, and next morning the paralysis is found to be complete. Rarely the onset is in a few minutes; probably then a hæmorrhage into the nerve-sheath is the cause. When inflammation is excited by cold, the symptoms often commence within twenty-four hours of the exposure. They are usually preceded or accompanied by some pain about the ear or side of the head.

In complete unilateral facial paralysis all the muscles on one side of the face are paralysed. At rest, the smooth forehead and lowered angle of the mouth are the chief indications, but on movement the difference between the two sides becomes very marked; the one half of the forehead moves alone in frowning or elevation of the eyebrow. The eyelids cannot be brought together, and in the attempt to close the eye, the globe is rolled upwards, so that only the sclerotic appears between the gaping lids; the patient then often fancies that the eye is shut. During sleep the eye remains open. In smiling, the lips may be displaced altogether to the healthy side, from the unopposed action of the zygomatic muscles; the nostril of the affected side cannot be dilated; the upper lip cannot be raised; the cheek flaps loosely, from the relaxation of the buccinator; and, from the same cause, food accumulates between the jaws and the cheek. Whistling is impossible, from the paralysis of half of the orbicularis, and the lips cannot be approximated sufficiently even to permit of a candle being blown out. When the lesion is between the junction with the large petrosal and that with the chorda tympani nerves, taste is partly or entirely lost in the front of the tongue. The loss of power of recognising acid and saline substances is most marked; but bitters and sweets are also not tasted in this part. Such loss is common in neuritis from cold, and shows that the inflammation has extended some distance up the canal. In rare instances, loss of taste has followed division of the nerve outside the skull, probably always because secondary inflammation has passed up the nerve. The palate is never paralysed from disease of the facial nerve. It is certain that the opposite statement rests on defective observation or interpretation. Obliquity of the uvula is common under normal conditions. Defect of movement, to be significant, must follow the course of any associated palsy of external muscles. The nerve-supply of the palatine muscles has been proved to be from the spinal accessory.

In some cases giddiness attends the onset of facial paralysis. In slight forms there may not be complete loss of power; but the defect is at first pretty equally distributed over all parts of the face.

In cases which recover, some return of power takes place in from a week to two months, and improvement is usually earliest in the upper part of the face; the power of frowning, winking, and closing the eye being soonest regained; that of moving the lips and mouth returning last. Even after several months of immobility, recovery may take place, but in these cases it is rarely complete, and a troublesome condition is apt to supervene: some of the muscles, especially the zygomatici, become shortened in late rigidity, and hence at rest the naso-labial wrinkle is deeper on the paralysed than on the healthy side, although the possible movement may be much slighter. This condition sometimes comes on rather rapidly; there is generally, in addition, an associated over-action of the upper and lower facial muscles, whereby, for instance, the orbicularis palpebrarum and the zygomatic and other muscles about the mouth act together in undue degree; in smiling, the eye shuts; and on closing the eye, the mouth is drawn upwards. Sometimes there are also spontaneous clonic contractions. This late rigidity and over-action may prove very troublesome and constitute a nuisance, especially to the young, not less than the original palsy, and more serious in that it is enduring. The writer has known it induce a good-looking girl to put an end to her life. If the interruption of the nerve is absolute and permanent, the muscles remain toneless, and no contracture supervenes.

The electrical condition of the muscles is very important. It is that always seen in paralysis from nerve-lesion. The muscles, after a day or two of slightly increased irritability to both faradism and the slowly interrupted voltaic current, lose gradually their irritability to the former, retaining that to the latter, and even exhibiting to it increased irritability, so that they act to a smaller number of cells than do those on the healthy side. In the nerve, on the other hand, the irritability is lost to both forms of electricity, this loss proceeding *pari passu* with the degeneration which follows separation of the nerve from its nutrient centre. In slighter and more transient forms of facial paralysis, the change in irritability of muscle and nerve may be less; but even in most, which last only a few days, a slight change in irritability may be discovered. In the slightest cases (and in the earliest stage of more severe forms) there may be an increased irritability in the nerve, often most marked to the induced (faradic) 'shocks'—*i.e.* isolated currents. Considerable change in irritability is proof of considerable disease of the nerve, and is thus of the highest prognostic importance, but it is not distinct until after a week; if absent at the end of a fortnight, the disease is slight, and although the paralysis may still be complete, it will probably not last long.

Diagnosis.—The diagnosis of facial paralysis (commonly so-called—*i.e.* that due to disease of the nerve or its nucleus) is easy. It depends (1) on the implication of all the facial muscles, including those of bilateral use that escape in hemiplegia, because related to both cerebral hemispheres; (2) on the indication afforded by the electrical reactions that the nerve or its nucleus is diseased. Hence it is important to observe all the muscles of the face, and to ascertain the electrical reaction, in order to determine whether it is the variety now described, or is cerebral and really part of hemiplegia. The recognition of the place of the lesion is less easy. When within the pons, it is often associated with paralysis of the sixth nerve, or with hemiplegia of the opposite side from damage to the motor path to the limbs. At the base of the brain the auditory nerve is usually affected at the same time, but care must be taken not to mistake deafness due to ear-disease for an affection of the auditory nerve within the skull. When there are no other paralyses, the disease is probably within the bony canal. Deviation of the uvula is of no significance; affection of taste in the front of the tongue indicates disease within the canal. Special inquiry should be made for exposure to cold, ear-disease, syphilis, or a blow.

Prognosis.—The majority of cases of facial paralysis are due to disease of the nerve, and the prognosis depends on the evidence of the degree of damage to the fibres, especially on the indications afforded by an electrical examination, and also on the cause of the lesion. When this is progressive in nature, the interference with the nerve is necessarily persistent in duration. Thus, in facial paralysis due to a growth damaging the nerve, the prognosis must be grave. In syphilitic disease, on the other hand, it is good, provided the duration of the damage to the nerve is short. This is also the case in paralysis from cold, in which, however, the evidence afforded by electricity is of special importance.

In double facial paralysis, the evidence of central mischief renders the prognosis unfavourable, but recovery may be hoped for if the lesion is acute and the palsy incomplete. In syphilitic cases, the prognosis is, on the whole, good. In all cases of double facial palsy from peripheral neuritis, there is a similar affection of other parts, and the prognosis must be determined by the general character and course of the affection, and especially the degree to which the morbid blood-state is amenable to treatment.

Treatment.—The treatment of facial paralysis will depend on the probable cause. When due to its common mechanism—neuritis from cold, hot fomentations to the side of the head and face should be employed in the early stage of the affection, followed by a blister behind the ear. A blister should never be applied in front of the ear, over the opening of the canal, because it will cause some subcutaneous cellulitis, and such cellulitis may actually cause facial neuritis by spreading to the nerve-sheath in the canal. The side of the head should be protected from cold. Internal treatment of neuritis must vary according to the cause. If this is syphilis, iodide of potassium in 10 gr. doses may be given; if exposure to cold, diuretics and small doses of mercury in the early stage, followed by tonics. Electricity to the muscles is needed if the damage to the nerve is so severe as to entail secondary degeneration and consequent changes in nutrition. If there is no change in irritability at the end of a fortnight, recovery will probably occur so soon as to make electrical treatment superfluous. If needed, the voltaic current should be used, slowly interrupted by a commutator, or by the positive or negative pole being moved over the individual muscles (according as they react more readily to the one or the other), the opposite pole being placed over the nerve. Only such strength should be employed as produces distinct muscular contraction. Although electricity probably does no more, it keeps up the nutrition of the muscular fibres while the nerve is recovering. Ultimate recovery is thus more speedy and more complete than without local treatment. The application can be made quite well by the patient, one electrode being kept over the place where the nerve divides, the other moved (1) across the forehead; (2) along the eyebrow; (3) along the lowered upper eyelid; (4) along the raised lower eyelid; (5) beside the nose to the upper lip; (6) along the upper lip; (7) along the lower lip; (8) from the zygoma to the angle of the mouth. In (3) and (4) the current should be weaker than in the other places. Rubbing may be employed, the individual muscles being subjected to a process of gentle shampooing. The late contraction which occurs in severe cases is but little influenced by treatment. Gentle elongation of the muscles may be practised, and electrical applications should be stopped, since the stimulation of the sensory nerves may increase the late contraction by a reflex influence; its occurrence shows that a point has been reached when the influence of electricity for good can be but small.

In external mischief, and in intracranial disease, the treatment of the facial paralysis is usually subordinate to that of its cause.

The treatment of double facial paralysis presents no special points for consideration, except when it is part of multiple neuritis, the indications for which are described in a special article. W. R. Gowers.

FACIAL SPASM.—Synon.: Mimic cramp; Fr. *Tic convulsif.* When affecting the eyelids, Blepharospasm; Nictitation.

Definition.—Spasm, sometimes tonic but more often clonic, or both, involving some or all of the muscles supplied by the facial nerve, on one side or on both.

Ætiology and Symptoms.—Spasm in the face may be part of a wider convulsive movement, as in epilepsy, hysteria, chorea, or torticollis, diseases dependent on central changes. That which begins in, and is limited to one side of the face, may be due to irritation of the trunk of the facial nerve by growths, by an aneurysm, or caries of the temporal bone, or to an actual lesion of the motor centre for the face in the cortex of the brain. Spasm due to disease of the nerve may follow facial paralysis (*see* Facial Paralysis). Much more frequent, however, are cases, unilateral or bilateral, in which the affection comes on gradually, chiefly in females in the second half of life, after depressing emotion. It is probable that such cases are due to deranged functional action of the cortical motor cells, through which, we may remember, emotion is so extensively expressed. In such cases the affection usually begins on one side, often in the orbicularis palpebrarum; and if it spreads to the other side, this muscle is first involved. In another group of cases, affections of the eye lead to spasmodic closure of the lids—*blepharospasm.* In other cases beginning in the eyelids, no local cause can be detected, as in the local clonic spasm affecting the orbicularis palpebrarum, known as 'involuntary winking' or *nictitation,* which seems to be a pathological development of the normal process. This is also a common seat of the spasm in the face that is part of 'habit-spasm' or 'habit-chorea,' but it has no connexion with true chorea.

Facial spasm is painless. The spasm is usually increased by emotion, by voluntary movement, and by stimulation of the fifth nerve. Slight aural symptoms have been observed, referable to contraction of the stapedius. Usually the movement remains limited to the face; sometimes it spreads to the muscles of mastication, of the neck, &c. The spasm, in typical cases, is both tonic and clonic, clonic paroxysms occurring from time to time, and being fixed by tonic contractions, or *vice versâ.* All forms cease during sleep.

The only secondary form of facial spasm (besides that which supervenes on a paralysis of the nerve) is the clonic spasm in the frontales that is often met with in the form of 'torticollis' to which the writer has given the name of 'retrocollic spasm.' In this there are bilateral contractions in the muscles of the back of the neck, jerking the head backwards. These muscles are physiologically associated with the frontales, as may be seen when a person looks up, and this association is reproduced in disease.

Prognosis.—The prognosis of facial spasm is seldom good. If the cause can be discovered, it can rarely be removed, and the affection is generally most obstinate.

Treatment.—General tonics and local sedatives are the chief agents in the treatment of most forms of facial spasm. When there is evidence of direct irritation of the fifth or the facial nerve, counter-irritation by blisters may be tried. A careful search should be made for reflex causes, and if possible they should be removed, decayed teeth being extracted, and neuralgia relieved, although the result is generally disappointing, if the spasm has long existed. When there are tender places in the course of the fifth nerve, pressure on which stops the spasm, the hypodermic injection of cocaine at these places should be employed. Morphine, used as a sedative, has a general influence which makes the remedy almost worse than the disease. Iron, quinine, or valerianate of zinc are the best general tonics. The writer has once known recovery to follow the administration of bromide, Indian hemp, and nux vomica; the case was characteristic, occurring late in life. The operation of nerve-stretching has often arrested the spasm for a time, and, in a few cases, permanently. It deserves a trial in severe cases, acting, perhaps, by the effect on the centres of the arrest of afferent impulses produced by the muscular contractions. These must tend to maintain the morbid state of the deranged cells. Its effect might probably be augmented by the simultaneous use of sedatives, such as the injection of cocaine to lessen the influence of the fifth nerve on the facial centre. Where the affection springs from an habitual movement, facial gymnastics may be of service. A weak voltaic current, applied from the ear to the muscles, unbroken, has been recommended; but it rarely, if ever, effects a cure. The same is true of the application of voltaism to the sympathetic and to the back of the head. *See* EYE, AND ITS APPENDAGES, Diseases of. W. R. GOWERS.

FACIES HIPPOCRATICA (Lat.)—A peculiar expression of the face, so named from having been graphically described by Hippocrates. It is most strikingly observed in persons exhausted by copious discharges, as in cholera, by prolonged wasting diseases, or by starvation; and especially before impending death. It is thus described by Hippocrates: 'A sharp nose, hollow eyes, collapsed temples; the ears cold, contracted, and their lobes turned out; the skin about the forehead being rough, distended, and parched; the colour of the whole face being green, black, livid, or lead-coloured.'

FÆCES, Examination of.—*See* STOOLS.

FÆCES, Involuntary Discharge of. *See* DEFÆCATION, INVOLUNTARY.

FÆCES, Retention of.—ÆTIOLOGY.—In the absence of mechanical obstruction, such as that due to adhesions, bands of false membrane, uterine pressure, stricture, tumours or hæmorrhoids, the main causes of fæcal accumulation are:—(*a*) A sub-paralysis of the intestinal muscular fibres from defective innervation, or from over-distension of the walls of some portion of the large bowel; (*b*) loss of reflex irritability of the rectum; and (*c*) dryness of the mucous surface of the colon. Hence it is frequently met with in the debilitated, the bedridden, the paralysed, the aged, and the sedentary; and women are more prone to it than men. Loss of reflex sensibility in the rectum is frequently the sole cause. The fæces delivered into the rectum by the contractions of the sigmoid flexure and the descending colon no longer excite the act of defæcation; and collecting there as a large desiccated mass, they determine a gradual and painless retention in the large intestine, and particularly in the most distensible parts—the sigmoid flexure and the cæcum. The accumulation once set up tends also to perpetuate itself, by arresting more and more the peristaltic movements of the distended bowel around the collected fæces.

SYMPTOMS.—Fæces often accumulate slowly and without the knowledge of the patient. Hence in cases in which sensibility has been blunted by age, disease, or great debility, the discovery of large collections in the rectum or colon may surprise even the practitioner, who is generally led to a local examination by disturbances set up by the retention. There is usually constipation or an insufficient discharge of solids; a regular and possibly excessive relief of the bowels does not, however, exclude accumulation, for even fluid fæces may pass through or over old collections. The evacuations are lumpy, or consist of detached hard, dry, dark scybala, or of a single mass; and when the accumulated matters are dislodged by aperients, they often emit an offensive and sour odour. Not uncommonly, however, the alvine discharges are entirely fluid or semifluid, and consist chiefly of mucus tinged with fæces. Fæcal collections in the rectum and sigmoid flexure are apt to excite tenesmus and frequent voiding of mucus and blood—a condition resembling that of chronic dysentery, but without the putrid-flesh-like odour of dysenteric evacuations; and the finger encounters a mass of hardened fæces in the rectum. A collection of fruit-seeds—as of the fig—in the rectal pouch will also set up these symptoms.

An accumulation in the cæcum, or in any part of the colon, may be detected through the abdominal wall as a tumour more or less movable, uneven or nodulated, and doughy to the touch; and on the finger being firmly pressed into it, presenting a depression which may last for some minutes. In rare cases the large bowel throughout may be so greatly distended as to apparently fill the abdomen with a solid mass, which, like other fæcal collections, yields to the firm pressure of the finger. A tympanitic state of the abdomen may, however, so obscure the examination as to prevent the recognition of even moderately large accumulations. The fæcal tumour in the cæcum is globular; but in any part of the colon it is usually elongated; and in the descending colon and sigmoid flexure it is harder than elsewhere, and very distinctly nodular from scybala. It may drag the transverse colon downwards, even as low as the symphysis pubis; and when confined to the right half of the transverse colon it may be mistaken for an enlarged liver.

But in other cases the retained fæces set up more or less severe abdominal disturbance—such as colicky pains, great distension, &c.—which may terminate either gradually or suddenly in complete intestinal obstruction, now and then proving fatal (*see* INTESTINAL OBSTRUCTION). Usually, however, several obstructive attacks of increasing severity succeed one another at intervals, being relieved either spontaneously or by the use of enemata and aperients. Ulceration of the intestinal mucous membrane is also apt to follow the continued retention of fæces, and may lead to fatal perforative peritonitis, or to stricture from the healing of the stercoral ulcer. *See* Cæcum, Diseases of; Colon, Diseases of; and Constipation.

Treatment.—A hard ball of fæces, or of agglutinated scybala, or fæcal concretions in the rectum resisting dislodgment by aperients or enemata, should be broken up and removed by introducing within the sphincter two or three fingers and a scoop, or the handle of a spoon; this procedure in the female being facilitated by the fingers in the vagina. An attempt may be made as a preliminary measure to macerate the hard fæcal mass by a cacao-butter suppository or injecting a few ounces of warm olive-oil. Sometimes a glycerine suppository or glycerine injection (ʒij.) will excite and aid the natural efforts in expelling the obstruction. Symptoms of obstruction should be met by injecting by the stomach-pump tube, or Davidson's syringe, large quantities—from 80 to 120 oz.—of some warm fluid such as soap-water or gruel, through the long rectal tube passed its full length; and it is often advisable to repeat at intervals the injection of even large quantities until relief is obtained. Care must be exercised in the use of the long tube not to injure the bowel; as well as in the injection of large quantities of fluid. If the indurated mass (as when in the lower parts of the large bowel) can be traversed by the tube, warm olive-oil should be slowly injected, and afterwards the warm fluids in ample measure. As a rule, purgatives merely aggravate the vomiting induced by the obstruction, while large enemata usually afford direct relief. In the absence of vomiting, however, a brisk aperient—such as calomel, castor-oil, or colocynth with croton-oil—may afford timely aid in clearing away the fæcal accumulation. When aperients and enemata fail to dislodge the fæcal collections, and the abdomen becomes painfully distended, a combination of opium, belladonna, and aloes, given at regular intervals—the dose of aloes, at first small, being increased as the pain diminishes—may enable the bowel to overcome the difficulty; but when there is much pain, and, above all, obstinate and especially stercoraceous vomiting, opium and belladonna, or subcutaneous injection of morphine, should be given until the subsidence of these symptoms. In such cases belladonna alone pushed to large doses has been known to effect relief after the failure of other means.

Massage may afford aid in dispersing fæcal collections and improving the peristaltic action of the bowel; to be applicable, there should be little or no tenderness, and it should be addressed first of all to the distal side of any detectable fæcal tumour. Electricity may prove useful. *See* Constipation.

Distressing tympanites, which, thwarting the peristaltic movements, often intensifies obstruction, has been overcome by puncturing the bowel with a fine trocar or aspirator-needle, after failure of other measures.

The general medicinal treatment of the conditions that favour the recurrence of the difficulty should consist of a prolonged course of gentle, yet efficient, evacuants, combined with tonics. The gradual collection of fæces, the toneless state of the walls of the large bowel, the scanty secretion of intestinal mucus, and the loss, in many cases, of reflex sensibility in the rectum, require the persevering use of these remedies. A pill containing aloes, iron, belladonna, and nux vomica generally affords the most satisfactory results. *See* Constipation.

George Oliver.

FAINTING.—A popular synonym for syncope. *See* Syncope.

FAINTNESS.—Faintness signifies a feeling of great weakness or exhaustion, as if the subject of it were about to become exhausted, or to sink or faint.

FALLING SICKNESS.—A popular synonym for epilepsy. *See* Epilepsy.

FALLOPIAN TUBES, Diseases of. The oviducts are liable to the following morbid conditions:—(1) Malformations; (2) Displacements; (3) Contractions; (4) Dilatations; (5) Inflammation; (6) New-Growths; and (7) Tubal Pregnancy.

1. **Malformations.**—The Fallopian tubes may be congenitally wanting, either on one or on both sides; or they may be impervious; or, instead of a single opening into the abdominal cavity, there may be two or more.

2. **Displacements.**—The tubes may be stretched or widely displaced from their normal position by growths or effusions in their neighbourhood, such as ovarian, or parovarian.

3. **Contractions.**—These canals may be impervious, from inflammation of the lining membrane, or from peritonitis, pressure, or torsion.

4. **Dilatations.**—The Fallopian tubes may be distended, even to a great extent, by (*a*) mucous or serous fluid (*hydro-salpinx*); (*b*) pus (*pyo-salpinx*); or (*c*) blood (*hæmo-salpinx*). In hydro-salpinx the tubes, if much distended, become sacculated, giving rise to a string of cystic tumours. The fluid collects chiefly at the abdominal end of the tube, but occasionally it may escape, and in large quantity, through the uterus. Should the tube burst and discharge its contents into the peritoneal cavity, the results will be serious, especially if the fluid be pus. When hæmo-salpinx is the result of menstrual retention from atresia uteri, bursting of the tubes internally is liable to follow operations for the relief of the obstruction.

5. **Inflammation.**—Inflammation of the Fallopian tubes (*salpingitis*) is apt to be caused by gonorrhœal infection, or it may occur during the puerperal state. Stenosis or *pyo-salpinx* may be the result.

6. **New-Growths.**—The Fallopian tubes may be the seat of the following new-growths: fibroid tumours, mucous polypi, cysts, cancer, and tubercle. Fibroids resembling those of the uterus may attain a considerable size. Small polypi growing into the canal may partially obstruct the duct. The cysts are usually the so-called *hydatids of Morgagni*, an embryological relic; but other small simple cysts may be met with at the orifice of the tube, around the fimbriated extremity. Primary cancer of the Fallopian tubes rarely, if ever, occurs. Tubercle, however, may be primary, and may occur before puberty. It usually begins at the abdominal end, and may lead to blocking of the tube.

7. **Tubal Pregnancy.**—An important affection of the Fallopian tubes is that arising from disintegration of the lining membrane of the tube, producing destruction of the ciliated epithelium, and so affording a nidus for the attachment of the misplaced product of conception, which thus grows within the tube in some part of its course. This abnormality is apt to be attended with very grave results, bursting of the tube frequently occurring about the third month of gestation; and serious, sometimes fatal, internal hæmorrhage may hence ensue. Tubal gestation usually occurs on one side only, while other affections of the tubes are often symmetrical, a point of diagnostic importance. *See* PREGNANCY, Disorders of.

Regurgitation of blood, of septic matters, and of fluids injected into the uterus, sometimes takes place along the Fallopian tubes, and this accident is always attended by grave consequences. Hence the danger of injudicious intra-uterine irrigation with corrosive sublimate and other antiseptic solutions during the puerperal period, and more especially after early abortions.

Mechanical Obstruction of the Fallopian tubes is not an infrequent cause of sterility.

TREATMENT.—The diagnosis of affections of the Fallopian tubes being difficult, their treatment is likewise obscure, and must be in a measure guided by general principles in each case. In pyo-salpinx severe peritonitis and death may result from rupture of the sac, as may speedy dissolution from internal hæmorrhage in tubal gestation. In the former case, and in hydro-salpinx, puncture with the aspirator might be permissible were a clear and unequivocal diagnosis made; or, failing this, the removal of the affected tube by salpingotomy as the only alternative. But, although in the hands of some eminent specialists this procedure has been attended with satisfactory results in many cases within the past few years, as a rule, under ordinary circumstances, the diagnosis is surrounded by so many difficulties that such an operation can only rarely be justified.

ALFRED WILTSHIRE. T. MORE MADDEN.

FALSE MEMBRANE.—An inflammatory exudation of a fibrinous character, which is deposited in layers, chiefly on mucous surfaces, and occasionally on abrasions of the skin. It is well exemplified in diphtheria and plastic bronchitis. *See* DIPHTHERIA.

FAMILY DISEASES. — Diseases which are found to run in families, or diseases to which members of the same family seem peculiarly liable. *See* DISEASE, Causes of.

FARADISATION, Uses of. — *See* ELECTRICITY IN MEDICINE.

FARCY.—*See* GLANDERS.

FASCIÆ (*fascia*, a band).—The fasciæ are subjects of medical and surgical interest, with respect to their anatomical relations, the diseases to which they are liable, and certain points of diagnosis in connexion with them.

I. **Anatomical Relations of Fasciæ.**—The situation and connexions of the fasciæ, according as they are fasciæ of *investment* or fasciæ of *attachment*, are of the greatest practical importance in the following classes of diseases: (1) Suppuration; (2) Extravasations, and Cellular Emphysema; (3) Herniæ; (4) Dislocations and other injuries; (5) Diseases of Encapsuled Organs; and (6) New-Growths.

1. SUPPURATION.—The physical influences exerted by fasciæ upon pus are chiefly two. First, fasciæ may limit the size of an abscess, determine its tension and the many results of the same, and thus affect both the local phenomena and the general symptoms. Secondly, when the pus is not confined, the fasciæ serve to determine the course that it will take, and the situation in which it will discharge. Every abscess may be said to be influenced in this way by the relations of fasciæ, but certain fasciæ have to be specially noted as causing pus to burrow, and hence they should be enumerated here.

(*a*) *Fasciæ of the Head and Neck.*—The fasciæ of the scalp; the temporal fascia; the cervical fascia; and the post-pharyngeal fascia, which conducts pus from the cervical vertebræ to the parotid region and tonsil, and to the region of the carotid vessels.

(*b*) *Fasciæ of the Upper Extremity.*—The axillary fascia; and the deep fascia of the upper extremity generally, including the palmar fascia and the sheaths of the tendons.

(*c*) *Fasciæ of the Thorax.*—The fasciæ of the intercostal spaces and of the mammary region; the fasciæ reaching from the neck to the upper part of the pericardium and the aorta, and to the posterior mediastinum, respectively; the fasciæ of the anterior mediastinum; and those connected with the diaphragm—all of which determine the course of intrathoracic abscesses (*d*) *Fasciæ of the Abdomen and Pelvis.*—The transversalis fascia; the fasciæ connected with the transversalis muscle, especially posteriorly, which influence the course of lumbar abscess; the sheaths of the psoas and the iliacus muscles; the pelvic, recto-vesical, obturator, and anal fasciæ; the fascial investment of the prostate; the superficial and deep layers of the superficial fascia of the perinæum; the superficial and deep layers of the triangular ligament; and the fascial investments of the rectum, bladder, uterus, and vagina, which determine the course of purulent collections in the pelvis.

(*e*) *Fasciæ of the Lower Extremity.*—The fascia lata and its processes; the tensor fasciæ femoris; the popliteal fascia; the deep fascia of the leg; and the plantar fascia and its compartments.

2. EXTRAVASATIONS AND CELLULAR EMPHYSEMA.—When blood or urine escapes from its natural reservoirs, or when air or gas has found its way amongst the tissues, the direction that the extravasated substance takes is markedly influenced by the fasciæ with which it comes in contact. The principal fasciæ of importance in this respect are as follows:—

(*a*) *Fasciæ of the Head and Neck.*—The fasciæ of the scalp, and the cervical fascia.

(*b*) *Fasciæ of the Thorax.*—The fasciæ of the intercostal spaces; and the mediastinal fasciæ, through connexions with the cervical.

(*c*) *Fasciæ of the Upper Extremity.*—The deep fascia in general.

(*d*) *Fasciæ of the Abdomen and Pelvis.*—Scarpa's fascia, or deep layer of the superficial fascia; both layers of the superficial and of the deep perineal fascia; and the fasciæ of the prostate and bladder—all being of the greatest importance in cases of extravasation of urine or fæces.

(*e*) *Fasciæ of the Lower Extremity.*—The fascia lata in general; the popliteal fascia; the deep fascia of the leg; and the plantar fascia.

3. HERNIÆ.—The occurrence of herniæ, and the direction that they take, are in a great measure determined by the condition of the fasciæ in contact with the viscera. Most important in this relation may be mentioned the fascia transversalis, the iliac fascia, the sheath of the femoral vessels, the obturator fascia, the cribriform fascia, and the fascia lata.

4. DISLOCATIONS, &c.—Certain fasciæ serve as supports for the heads of bones, and for the viscera; and these will have an important influence either in promoting or in preventing dislocation, displacement, or other injury of these parts, as the case may be. The shoulder is supported by the costo-coracoid fascia, and this relation considerably affects the signs of dislocation at that joint. In fractures of the patella, the fasciæ of the knee-joint promote separation of the fragments. The fascia of the neck helps to support the pericardium, and must limit the displacements of the heart. The bicipital fascia of the forearm protects the brachial artery beneath it in venesection, at the bend of the elbow. On the other hand, the attachment of the cervical fascia to the jugular veins facilitates the entrance of air into the circulation through a wound at this point. And, lastly, the pelvic viscera are supported by the transversalis, pelvic, iliac, and recto-vesical fasciæ; whilst the cord and testis have their special fasciæ to keep them in position.

5. DISEASES OF ENCAPSULED ORGANS.—A considerable number of organs, many important vessels, and a great variety of muscles are contained in distinct fascial capsules, sheaths, or envelopes, which will affect the course of the diseases of these structures in many ways—defining their limits, or determining the direction in which they spread, and thus influencing both their local and general phenomena. This has been already alluded to under the first head; but it is necessary to enumerate here the principal fasciæ that act in this way, namely: (*a*) *Arterial sheaths*: of the carotid, subclavian, thoracic-aortic, and femoral. (*b*) *Muscular sheaths*: of the masseter, buccinator, psoas, iliacus, quadratus lumborum, erector spinæ, pectineus, rectus abdominis, levator ani, tensor vaginæ femoris, and the palmar and plantar muscles. (*c*) *Visceral capsules*: of the thyroid gland, parotid and submaxillary glands, tongue, prostate, penis, vagina, bladder, rectum, and mamma.

6. NEW-GROWTHS.—The direction, rapidity, and extent of spread of new-growths are considerably modified in certain situations by the relations of the fasciæ above described.

II. Pathological Relations of Fasciæ.—The principal diseases of fasciæ are: (1) Inflammation and its results; (2) Ossification; (3) Calcification; (4) Rheumatism; (5) Gout; (6) Syphilis; (7) Contraction; and (8) Extension. None of these conditions can be said to be common, or of serious importance.

1. INFLAMMATION.—Inflammation involving a fascia is usually secondary, having spread to it from the neighbouring structures, and especially from the muscle or organ of which the fascia may form the sheath. Even under these circumstances, a fascia rather resists than participates in the inflammatory process, as has been described above; and when it is involved, it tends to ulcerate on account of its feeble vitality, and to be discharged in the form of sloughs. The healing process is extremely slow in fasciæ, and after serious lesion their function is never completely restored.

2. OSSIFICATION.—Occasionally in aged persons portions of fasciæ are found transformed into bony tissue.

3. Calcification.—Calcification is very rare in fasciæ.

4. Rheumatism.—The condition known as muscular rheumatism, or according to its situation as lumbago, torticollis, &c., is believed by some authorities to involve the fibrous coverings or fasciæ of the affected parts. In the same way, many of the aches of some forms of 'chronic rheumatism' may possibly have their seat in fasciæ; and certain cases of neuralgia are probably to be referred to rheumatic inflammation of the nerve-sheath.

5. Gout.—Amongst the pains of the gouty subject are some which are no doubt due to affections of fasciæ, such as pains in the heel and instep, and neuralgia of the sciatic, the anterior crural, and the brachial nerves.

6. Syphilis.—Syphilis may attack the fasciæ in the form of nodes, which in situations of low vascularity are apt to ulcerate, as, for example, at the inner aspect of the knee.

7. Contraction.—Contraction is the most obvious of the morbid conditions of fasciæ, giving rise as it does to well-marked deformities. The fasciæ of the hand and foot are most liable to this change, with the result of unnatural flexion of the fingers and toes. Such contraction of the palmar and plantar fasciæ may be due to wounds, burns, or inflammation from any cause, or to gout or rheumatism; it is sometimes congenital; and it sometimes occurs without evident cause.

8. Extension.—A fascia or sheath, though extremely inelastic, is liable to be stretched by swelling of the parts which it envelops; and, if the cause do not speedily disappear, may remain more or less permanently extended. The best instance of this condition is pendulous abdomen after pregnancy or other kind of abdominal enlargement.

J. Mitchell Bruce.

FASCIOLA (*fasciola*, a thin band).—A genus of trematode parasites of which the common liver-fluke forms a good type. This entozoon (*F. hepatica*) is characterised by the possession of a branched intestinal canal, thus differing from the flukes belonging to the genus *Distoma*, in which the canal is simple and bifurcated. The liver-fluke is of rare occurrence in man, though extremely abundant in, and destructive of, ruminating animals. *See* Entozoa.

T. S. Cobbold.

FASTING.—The manifestation of vital activity implies consumption of material; and unless the supply of material in the form of food is equivalent to the loss occurring, a progressive wasting of the body and failure of power must ensue. Hence these phenomena constitute the necessary accompaniments of fasting; and with its prolongation the question resolves itself into one of time—when the exhaustion of material shall have proceeded to such an extent as to render the continuance of life impossible.

Pathology.—To Chossat we are indebted for showing that the immediate cause of death from fasting is a reduction of the body temperature. At first there is a gradual, but not very extensive fall. Afterwards a more rapid decline occurs, until the reduction amounts to about 29° or 30° F. below the normal point, when death ensues. Chossat noticed that if, whilst in the state of torpor preceding death, the temperature of the animal experimented on was raised by exposure to artificial warmth, a restoration of consciousness and muscular power was induced; and some of his subjects of experiment which were thus rescued from impending death afterwards thoroughly revived on being supplied with food.

Symptoms.—The most prominent symptoms arising from fasting are those due to the special sensations produced by the absence of food and fluid, and those attributable to a decline of the physical and mental powers. In the first place there is great uneasiness in the epigastrium. This is followed by a sense of sinking in the same region, accompanied by insatiable thirst; and if fluid be persistently withheld as well as food, the thirst becomes the chief source of distress. The countenance assumes a pale and cadaverous appearance, and a look of wildness is presented about the eyes. Emaciation becomes more and more marked, and with it there is a decline of the bodily strength. There is also failure of the mental power. Stupidity may advance to imbecility; and a state of maniacal delirium frequently supervenes. Life terminates either calmly by gradually increasing torpidity, or, it may be, suddenly in a convulsive paroxysm.

Duration of Life.—The usual duration of life under complete absence of food and drink may be said to be from eight to ten days. The special circumstances existing may, however, exert a modifying influence, and from the nature of these the period may be either diminished or increased. A stout person, as may be readily understood, has a chance of living longer than a thin one, on account of the store of combustible material which may be drawn upon being larger. Exposure to cold in conjunction with starvation very much hastens death. The presence of moisture in the atmosphere favours the prolongation of life, by diminishing the exhalation of fluid from the body. It may be assumed to be owing to the existence of warmth and moisture that persons buried in mines, or otherwise similarly placed, have been known to live considerably beyond the ordinary period.

The Welsh fasting girl, whose case caused so much sensational excitement in 1869, lived exactly eight days from the time she was placed under systematic inspection to solve the problem of whether she could exist, as had been alleged by her parents, for an indefinite period without food. It appears that during the first part of the time she was cheerful and exhibited nothing extraordinary. Later on it was found that she could not be kept warm, and ultimately she sank into a state of torpor from which she could not be roused, and which speedily terminated in death.

In the Troedyrhiw colliery near Pontypridd an inundation occurred in 1877, which led to the imprisonment of four men and a boy in one of the headings of the mine. The accident happened on Wednesday evening, the 11th of April. Efforts were at once made, by means of a cutting, to reach the chamber in which the imprisoned persons were confined, and to release them. This was not accomplished till the afternoon of Thursday, the 19th, when all were rescued alive and did well. They had been imprisoned in an atmosphere of compressed air nearly eight days, without food but within reach of water.

The performances of professional fasting men give a much longer time as that during which life can be sustained without food. Two feats of fasting were performed before the London public during 1890 by separate men. The first was announced to be for a period of forty, and the second for a period of forty-five days. Both were carried on for the specified time, and, through the payments received from the crowds of spectators admitted, must have proved lucrative undertakings. One of them subsequently became insane. Feats thus conducted for pecuniary gain, and supervised, as was here the case, by newspaper reporters as watchers, can hardly, it may be considered, be regarded as holding a sufficiently trustworthy position to command acceptance for the purposes of a medical work like this, whatever the amount of popular credence given to them at the time. In the case of the Welsh fasting girl watchings of considerable duration had been performed through which she had successfully passed, but the last watching was carried out by the experienced London nurses deputed to undertake the task with a strictness that defied deception, and with the result that death took place as stated.

In the case, again, of Ann Moore, of Tutbury, in Staffordshire, which, from the account published, must have attained great notoriety in the early part of the present century, watchings had been conducted in a manner to admit of testimony being given in support of her veracity; but ultimately a watching was so seriously undertaken, and with such zeal carried out, as to lead to her being brought by the ninth day into a sinking condition, when she took food, and afterwards made a written confession of the imposition that had been previously practised.

That a very small amount of food will suffice for sustaining life for a prolonged period is evidenced by what may be observed in some cases of constrictive disease affecting the œsophagus or cardiac orifice of the stomach.

TREATMENT.—Caution is required in the administration of food after prolonged fasting. Sudden transitions of all kinds are trying to the body; and, instead of allowing the rescued sufferer to gratify his desire to eat and drink according to his inclination after several days' abstinence, the supply of both food and drink should at first be limited, and afterwards gradually increased. There is reason to believe that the non-observance of this rule has upon some occasions been followed by disastrous consequences, which a different plan might have averted.

F. W. PAVY.

FAT.—Fat becomes morbid under a variety of circumstances :—

1. **Obesity.**—Fat may be found generally diffused in excessive quantity beneath the skin, beneath serous membranes, and in and upon various tissues and organs of the body. This condition constitutes what is known as obesity. *See* OBESITY.

2. **Partial Growth.**—A partial growth of fat sometimes occurs in paralysed muscles, and constitutes a characteristic feature of what is called pseudo-muscular hypertrophy. *See* PROGRESSIVE MUSCULAR DYSTROPHY.

3. **Fatty Interstitial Growths.**—Fat as fat-tissue more especially constitutes a disease when it is deposited upon and in the textures of organs, interfering with their structure and functions. This it does by pressing upon the histological elements of the organ invaded. Its effects are more clearly seen when it invades the muscular tissue of such an organ as the heart, the fibres of which, becoming more or less atrophied and distorted in their course and direction, are rendered inadequate for the performance of their functions. *See* HEART, Fatty Growth on.

4. **Fatty Tumours.**—Fat may also occur in isolated or circumscribed masses, constituting what are known as *fatty tumours* or *lipomata*. *See* TUMOURS.

5. **Fatty Infiltration.**—*See* FATTY INFILTRATION.

RICHARD QUAIN.

FATIGUE (*fatigo*, I weary).—GENERAL REMARKS.—Fatigue is a regular and constantly returning symptom experienced by all persons. Periods of functional activity invariably alternate with periods of repose, during which the waste caused by the exercise of function is repaired. We are indebted to Sir James Paget for having pointed out that 'rhythmic nutrition is a law of nature,' and although the truth of this dogma is recognised on all hands, and may be said to be axiomatic, it has hardly received that careful consideration at the hands of practical physicians which it deserves. Our whole life is composed of a series of vibrations—periods of tension alternating with periods of relaxation; and although the rapidity of these vibrations varies immensely, they are recognisable in all our acts, whether voluntary or otherwise. The vibrations of the heart are about seventy in a minute, those of the respiratory organs about sixteen. The whole body requires a certain period of absolute and continuous repose in each twenty-four hours (amounting to nearly one-third of the period), so that we may say its rate of vibration is once in the twenty-four hours. In like manner, the period of relaxation of the heart is about one-third of the total period of action, and this proportional correspondence between a local and a general condition is not a little interesting and suggestive. Again, it is universally ordained amongst civilised nations that once in every seven days there shall be a remission of labour and a change of occupation; and we recognise the fact that it is highly advisable for those who are occupied in one pursuit to break away from it at least once a year and indulge in that variety of work which we call amusement.

Fatigue occurs directly we attempt to alter the rhythm of our vital vibrations by prolonging the periods of tension at the expense of the period of relaxation, or by demanding for any length of time a quickening of the normal rate of vibration. We recognise the fact that athletes who over-train run risks of cardiac troubles and loss of wind; that the man who from any cause is unable to sleep runs a serious risk of permanent impairment of health; and when we find patients pursuing their avocations too zealously we know that, if such offence against the laws of nature be persisted in, general paralysis, or other forms of 'break-down,' are likely to be the result.

Description.—Fatigue may be either *general* or *local*, and both forms may be either acute or chronic. That fatigue in all its forms is due to impaired nutrition there can be little doubt, and we shall find that the symptoms of chronic fatigue are often the prelude of definite and recognisable degenerative changes.

General Fatigue.—General fatigue is recognised with ease both in its acute and chronic forms. There is a disability to perform either mental or physical work, and this disability is noticed first in work requiring attention or sustained effort, and last in those acts which have become automatic or secondarily automatic. The symptoms of general fatigue are usually referable to the nervous centres.

Local Fatigue.—Local fatigue is either acute or chronic, and the symptoms of it are referable usually to the muscles; but we must always bear in mind that muscle and motor-nerve are practically one and indivisible, and that recent experiments have given great probability to the idea that every muscle is connected with a certain definite spot in the brain. When, therefore, we speak of a sense of fatigue, we must necessarily be in doubt, notwithstanding the fact that the symptoms are apparently located in the muscles, whether the brain, nerve, or muscle, one or all of them, be really at fault.

Acute local fatigue.—The first symptom of acute local fatigue is loss of power to a greater or less extent. By too frequent or too prolonged stimulation the irritability of the muscular tissue becomes exhausted, and it either refuses to respond, or responds but feebly to the stimulus of the will; whilst our power of adjusting the force of contraction to the act to be accomplished is lessened, and accuracy of movement and delicacy of co-ordination are destroyed. The second symptom is tremor, as everyone must have experienced who has been called upon for any unusual exertion. The third symptom is cramp-like contraction; and the fourth is pain, the pain being the pain of fatigue, and absolutely distinct from other varieties of pain. Fatigue is caused far sooner by prolonged muscular effort than by repetitions of short muscular efforts having due intervals of relaxation between them. Any one who has attempted to hold out a weight at arm's length knows the impossibility of continuing the effort for any length of time; and it is proverbially true that standing in one position is, to most people, far more tiring than walking, the reason being that in standing the muscles which support the body are subjected to a prolonged strain, while in walking we use the muscles on either side of the body alternately. The great increase of power which we obtain by using the muscles on either side of the body alternately would seem to be one of the chief reasons for the bilateral symmetry of the body. Not only is sustained effort a far more potent cause of fatigue than repeated effort, but we find that when fatigue supervenes, actions requiring sustained effort are the first to fail; and in this local fatigue resembles general fatigue. The last acts to be affected by fatigue are such as are automatic, and are accomplished without mental effort, and by the expenditure of the least possible amount of force. It is quite possible to exhaust a muscle by artificial stimulation, and if one of the small interossei muscles be continuously faradised, it will be found that in time its power of contraction to any form of stimulus may be absolutely abolished. It is tolerably certain that the brain can have no share in artificial fatigue thus produced, and there seems good reason to suppose that, in some people of energetic temperament, the irritability of a muscle may be exhausted, while the power of mental stimulation remains almost unimpaired.

Chronic local fatigue. — This form of fatigue has causes and symptoms similar to those of acute local fatigue, and there can be little doubt that this condition is a common cause of many of those chronic maladies which seem to result from over-work, and are characterised by irregular muscular action. That some cases of writer's cramp (*see* WRITER'S CRAMP) are due to chronic fatigue of certain muscles employed in writing, and particularly of those subjected to prolonged effort, cannot be doubted. Some cases of torticollis seem due to the same cause. Duchenne and Brudenell-Carter have pointed out how, in cases of 'short sight,' the strain on the internal recti has caused troubles of vision, and even brain symptoms; and Mr. C. B. Taylor of Nottingham has shown reason for including in the category of fatigue-diseases a peculiar form of nystagmus, occurring amongst miners, who try their eyes by working in the dark. Dr. Augustus Waller, working at this subject from the physiological point of view, states that when a muscle is fatigued by over-stimulation of a motor nerve, it is the motor end-plate (the junction between nerve and muscle) which first fails to conduct the stimulus; and Dr. Reid, working in conjunction with Dr. Waller, has shown that when stimulation takes place from the brain, failure by conduction occurs first in the cord, where the ganglionic cell forms a junction between the fibre of the pyramidal tract and the fibre of the anterior nerve-root.

TREATMENT. — The treatment of fatigue in all its forms is *rest*, and the restoration of the proper rhythm of nutrition, if this be found perverted, by substituting rhythmical exercises for unrhythmical efforts.

G. V. POORE.

FATTY DEGENERATION. — SYNON.: Fr. *Dégénérescence graisseuse*; Ger. *Fettige Metamorphose.*

DEFINITION.—The process by which protein elements are converted into a granular fatty matter.

SEATS OF OCCURRENCE.—This change may occur in any of the component elements of the body, whether normal or abnormal.

Physiologically.—The production of milk from the protoplasm of the mammary cells, and of sebum from the cells of the sebaceous glands, are instances of fatty degeneration. The cells of the corpus luteum are partly in a condition of fatty degeneration; and it is by a similar change in the peripheral cells of the mature fœtal portion of the placenta that normal involution of that organ is accomplished. Non-vascular structures, such as the cartilages, the cornea, and the intima of blood-vessels, frequently undergo fatty transformation of part of their substance. In a less marked form, fatty degeneration occurs in the walls of the uterus and other muscular organs when returning to their ordinary size after temporary hypertrophy.

Pathologically.—As a purely morbid process, fatty change is most frequently met with in the muscular tissue of the heart, in the walls of capillaries, and in the urinary tubules; but it also occurs in the central nervous system, constituting the condition known as 'white softening'; in the liver; and in tubercular deposits, cancerous growths, infarcts, and inflammatory products in any situation whatsoever.

ANATOMICAL CHARACTERS.—*Physical characters.*—An organ that has undergone fatty degeneration presents the following physical characters. The bulk and weight are generally increased; the consistence is reduced—sometimes to a pulp, as in white softening of the brain; the colour is changed, either as a whole or in the affected portions of the organ, into a buffy or yellowish bloodless hue; and the resistance or firmness is diminished, so that the affected tissue is markedly flabby, and readily yields to pressure. The solid cut surface may appear compact and shining; and the section leaves a greasy stain upon the knife and fingers. When fatty degeneration is greatly advanced, as it may be seen, for example, in the liver, a portion of the organ thrown into water will float.

Microscopical characters.—In fatty degeneration the muscular tissue of the heart (*see* fig. 60) and the walls of capillaries are most suitable—especially those of the brain—for microscopical investigation. The earliest changes in the *cardiac muscle* in fatty degeneration are loss of sharpness of the individual striæ, and the appearance of minute particles of oil between the elements. These changes, beginning near the nuclei, spread throughout the fibres in a longitudinal direction, while the particles increase in size, and assume the well-known characters of oil-globules. When the process is advanced, the whole of the sarcous substance is replaced by fatty particles contained within a delicate albuminous envelope. Finally the degenerated fibres either become atrophied by absorption of certain parts of the fat, and so disappear; or suffer rupture with discharge of their contents. The fatty nature of the change is proved by the solubility in ether of the particles that have escaped from the fibres.

Fatty degeneration of the *walls of vessels* is best seen in the capillaries and smallest arteries. The tunics first lose their normal translucency; minute granules appear in their substance; and these increase to form unmistakable oil-globules. Finally, the vessel gives way, and the oily particles and blood are discharged into the perivascular spaces.

In the other organs referred to, the microscopical characters agree with those just described, with certain differences dependent upon the special structure of each. Thus fatty degeneration of a leucocyte leads to the formation of the body known as a *compound granular corpuscle,* in which the oil-drops finally replace the whole of the protoplasm. In 'white softening' of nervous tissue, the nerve-cells and probably all the nuclei of the part are converted in a great measure into granular corpuscles; and these breaking down into a fatty detritus, the whole constitutes a soft creamy-looking substance, which, as Virchow expresses it, 'is milk in the brain, instead of in the mammary gland.' 'Yellow tubercle' consists in part of cells and nuclei that have undergone fatty degeneration, and of fatty detritus. In the case of the uterus during involution the fat is probably rapidly absorbed, so that the appearances presented to the eye are those rather of atrophy than of replacement of the muscular substance by fat.

Pathology.—We have now to trace whence comes the fat that is found in this form of degeneration, and how. It is evident that in a number of instances—such as the production of milk and sebum—fatty degeneration is a truly physiological change, which is subservient to health when active, while its derangement or cessation constitutes disease. In other cases the process is essentially pathological, as, for example, in fatty degeneration of the heart and white softening of the brain; the functional activity of the part being impaired, or so abolished that the name of *necrobiosis,* or death-in-life, has been given to the condition. The fatty change in the two instances is, however, manifestly one and the same. The condition known as fatty degeneration had long been described, and it has always been a favourite subject with pathologists to discover its nature and its cause. It was generally assumed that the fatty matter present was introduced from without, being deposited from the blood as morbid material in place of the pre-existing tissues which were absorbed. Modern research has demonstrated that this is not so, and that fat is derived from a molecular change in the tissue or textures in which it is found. The subject is one of immense importance, involving the whole field of pathology; and it is but right to state that our acquaintance with the true nature of the process is almost entirely due to the investigations of Dr., now Sir Richard, Quain, which were published in the *Medico-Chirurgical Transactions* for 1850, and with reference to which Sir James Paget has remarked: 'Dr. Quain has candidly referred to many previous observers by whom similar changes were recognised; but the honour of the full proof, and of the right use of it, belongs to himself alone.'[1] Quain's conclusion, as then stated, was that the molecular fatty matter in the degenerated fibre was the result of a chemical or physical change in the composition of the tissue, occurring independently of those processes which we call vital. The arguments which he adduced in support of this view were the following: (1) That in the formation of the substance known as adipocere from albuminous material after death, the places of the muscular fibres, blood-vessels, and nerves are occupied by fatty matter which could not have existed in them as such during life. (2) That a true fatty degeneration may be artificially produced *post mortem.* (3) That masses of albuminous material deprived of nutrition in any part of the body, or the centre of non-vascular structures such as tubercle, undergo fatty degeneration to a marked degree. (4) That the circumstances under which fatty degeneration occurs in the living body exhibit impairment of general and local nutrition, such as blood-disorder, or disease of the nutrient vessels.

More than twenty years later (1871) these conclusions were experimentally confirmed in the living animal by the investigations of Professors Bauer and Voit, of Munich. On administering phosphorus to a starving dog, in which the amount of nitrogen (urea) daily excreted had become constant, these experimenters found that the amount of the excretion was thereby increased threefold; that this nitrogen was derived from the albumen of the tissues and not of the blood; and at the same time that three times the normal amount of oil had accumulated in the viscera. This oil could have its origin only in the transformed or decomposed albumen of the organism; the other product being the urea which had been excreted. The same results have been observed in poisoning by phosphorus in the human body.

Many other instances of the formation of a fatty from a nitrogenous body might be adduced if necessary, such as the ripening of cheese; the increased flow of milk on a meat diet; the formation of wax by bees from sugar and albumen; the production of fatty acids and their allies from proteid compounds in the process of pancreatic digestion; the increase of oil in olives by keeping; and the development of a rancid oil in the flake of salmon under similar circumstances. The numerous instances just adduced combine to strengthen the position—which was, however, sufficiently established by Sir Richard Quain—that in true fatty degeneration, the nitrogenous material of the tissues themselves, and not the blood, must be considered the source of the oily matter. It has been said that the circumstances under which fatty degeneration occurs are further confirmatory evidence in the same direction. These must now be considered.

Conditions of Occurrence.—The circumstances under which fatty degeneration occurs are either such as affect the nutrition of the whole system generally, or of a given organ, or portion of it, specially.

---

[1] *Lectures on Surgical Pathology,* 1st ed. vol. i. p. 107, note.

General.—When the amount of blood in the body is quickly reduced—for example, by severe but not actually sudden hæmorrhage, and in anæmia—death may occur from fatty degeneration of the heart, the voluntary muscles and the other viscera being likewise, but less seriously, affected. Again, general fatty degeneration is frequently due to depraved quality of blood, and especially to the presence in it of certain poisons, such as phosphorus, arsenic, antimony, and the more complex animal-poisons of the acute specific fevers.

Local.—Disease of the nutrient artery of a part is the morbid condition most frequently associated with localised fatty degeneration. A good instance of this is furnished by fatty degeneration of patches of the muscular tissue of the heart corresponding with degeneration, obstruction, or compression of a branch of a coronary artery. Another excellent example of the same is white softening of the brain from vascular degeneration. This is analogous to what occurs in dry gangrene, with the exception that decomposition takes place in the latter, probably from exposure to air.

Summary.—When we review the circumstances under which fatty degeneration is found to occur, we discover that the condition that is common to them all is interference with nutrition, and especially with the process of oxidation. The red corpuscles are believed to be primarily affected in phosphorus-poisoning; they are numerically reduced in continued hæmorrhage; and they do not reach the tissues in sufficient numbers when the vessels are obstructed, or otherwise diseased. In the cases of the hypertrophied uterus and heart, of the placenta, and perhaps of the corpus luteum, the degeneration is probably due to the decline or cessation of functional activity, and the consequent decrease in the blood-supply to the large mass of protoplasmic structures.

With respect to the *intimate* or *essential nature* of fatty degeneration, it may be stated as highly probable, as far as our present knowledge extends, that the metabolism or decomposition that is constantly going on in living protoplasm is not simple or immediate; but that a primary decomposition occurs of albuminous substances into urea (or its allies) and fat, and a further or secondary decomposition of the fat into carbonic acid and water. If the amount of oxygen furnished by the blood is deficient, whether absolutely or relatively, the primary decomposition of the protoplasm alone may be effected; and the secondary decomposition, or the oxidation of fat into carbonic acid and water, may not occur. The result therefore of an absolute or relative deficiency of oxygen in protoplasmic tissues will be the accumulation of fat within them.

Effects.—The physical effects of fatty degeneration of a tissue have been already described under the head of physical characters, being chiefly—change of colour, diminished consistence and resisting power, softening, rupture, dilatation and excavation, and alteration of size. The chief physiological effect is diminished functional power or activity, which is especially marked in muscular parts such as the heart, and in secreting organs, including the kidneys.

Treatment.—The subject of the treatment of fatty degeneration will be found discussed under the head of the diseases of the several organs which it may affect.

J. Mitchell Bruce.

FATTY INFILTRATION.—Fat in the form of oily particles is found to be present in excess in the cells of various secreting organs, constituting fatty infiltration. Thus it appears in the epithelium of the intestinal mucous membrane during digestion; in the cells of the liver and biliary passages; and in the kidneys of certain animals—for instance, the cat. When this condition becomes permanent it constitutes a disease. Glandular organs thus affected, as in the case of the liver, assume a buff or yellow colour, and they become softer and more friable than normal; whilst microscopically their cells are found to contain one or more large well-defined oil-globules, which tend to coalesce and occupy the cell. The quantity of oily matter in the cells may, however, vary from time to time, and the infiltration may be either of a transient or of a permanent character. In the one case, the function of the organ may not be materially interfered with; in the other case, the action of the cells may be so far affected as greatly to impair the secreting functions of the organ.

The causes of fatty infiltration are of two kinds—general and local. First, the *general* causes are (*a*) a superabundance of fatty matters in the blood, such as occurs in persons who indulge in rich food and in beverages containing alcohol; (*b*) imperfect oxidation, as in chronic tuberculosis of the lungs; and (*c*), according to some observers, the metastasis of fatty deposits from one part of the body to another.

Secondly, with respect to the *local* causes of fatty infiltration, one is a peculiar affinity or selective power of the cells of certain tissues, by virtue of which they incorporate with their substance oily or fatty matter. This facility has been explained, in the case of the cells of the liver and of the passages traversed by bile, by the presence of that fluid, which, as Virchow and others describe, is a powerfully determining cause of the infiltration of fat into protoplasm. Another local cause of the accumulation of oil in cells is their inactivity or imperfect power of eliminating it, as is found to occur in the cartilages of the aged, and in inactive or unused muscles.

It must be said here, with respect to the appearance of fat in the last-named situations, that though, in some cases, it is derived unquestionably from the fat contained in the blood or chyle, it may in other instances be derived from the disintegration of the protein elements of the tissues. This subject, however, will be found discussed in the article upon FATTY DEGENERATION.

RICHARD QUAIN.

FATUITY (*fatuus*, silly).—Mental imbecility. *See* IMBECILITY.

FAUCES, Diseases of.—*See* THROAT, Diseases of.

FAVUS (Lat. *a honeycomb*).—SYNON.: *Tinea favosa*; *Dermato-mycosis achorina*; Honeycomb Ringworm; Fr. *Teigne faveuse*; Ger. *Erbgrind.*

DEFINITION.—A chronic, contagious, parasitic disease of the skin of man and some animals, caused by the growth of the Achorion fungus (discovered by Schönlein in 1839), and characterised by the formation of peculiar yellow crusts, and by the occurrence of inflammatory and often atrophic changes.

ÆTIOLOGY.—Favus is somewhat less contagious than ordinary ringworm, and individual predisposition has a marked influence in its spread. The young are most prone to attack, and children living amidst sordid surroundings. Propagation occurs by direct contact and inoculation, and transmission of the complaint has been observed to and from mice, to the rat, cat, dog, fowl, guinea-pig, rabbit, horse, and ox. In England, where it is uncommon, favus is seen mostly in foreign immigrants; but it occurs more frequently in Edinburgh and Glasgow. It is comparatively common in the southern provinces of France and Italy, and amongst the male Jewish population of Russia, Poland, Galizia, and the Levant; the Mohammedans of Turkey, Asia Minor, Syria, Persia, Egypt, Algiers, and Morocco; also in parts of India, China, and Brazil.

SYMPTOMS.—The fungus develops beneath the upper layers of the epidermis, around the hair, setting up some inflammation, and presently appears as a little yellowish elevation. In some weeks the latter forms a characteristic, sulphur-yellow, sub-epidermic, lentil-sized, umbilicated disc (the *godet favique, scutulum, favus*), lying in a red, moist, cup-like bed fashioned by the pressure of the growth, and traversed by a hair. Gradually the fungus invades the hair-sheaths and then the hair, growing perhaps three or four centimetres above the level of implantation. The bulb usually remains free, and indeed the hair in favus is not invaded so quickly or abundantly as in trichophytosis, and, as a rule, is not nearly so disintegrated. The hairs become lustreless, dusty-looking, loosened, and finally atrophied and distorted. A characteristic mouldy smell is observable, which must be carefully distinguished from the stale scent of old dried-up pus. Favus may attack hairy regions, non-hairy parts, and the nails; but the scalp is far the most important site affected, on account of the intractability of the disease there, and the ensuing disfigurement. The characteristic cupuliform discs may attain to a diameter of about half an inch or more. They may remain isolated and disseminated, or be aggregated and more or less confluent. As they age, the colour fades or darkens by the admixture of exudations, and the consistence becomes more friable. They tend to lose their characteristic aspect, crumble and fall, to be replaced by others more or less imperfect. In course of time most irregular and atypical changes result from the effects of scratching and excoriation, and from pustulation. Secondary glandular inflammation can then arise. Finally, a disfiguring baldness may result; and as this occurs, the disease gradually dies out, but only after many years.

Regions of the trunk, extremities, or face, commonly spoken of as non-hairy, may be attacked primarily or often secondarily to the scalp. Here the favi are surrounded by inflammatory halos, or preceded by a ringworm-like eruption.

One or several nails of the hands, or even of the feet, may be inoculated, and then the favi form beneath, and gradually erode the nail. At the same time the nutrition of the latter is much impaired, and the structure disorganised.

DESCRIPTION OF THE FUNGUS.—The mycelium is composed of flexuous, ramified, tubular, partitioned, and articulated filaments. When fructifying, the tubes are charged with granules, with nuclei, and with perfect nucleated gonidia or spores. Both the mycelium and the abundant gonidia are characterised by a great diversity of size and form. The gonidia are mostly rounded and oval, and may be isolated or united in chains. It is now established that the fungus can be distinguished in cultures; and when inoculated from animal to animal, and to man, it always gives rise to the characteristic clinical appearances. The *godets* consist of mycelial threads branching towards the central part, and then terminating in chains of gonidia and granules.

DIAGNOSIS.—In the various forms of favus where at some time or other more or less well-marked *godets* are observable, the diagnosis is clear; and the peculiar smell, the persistence of the malady, the condition of the hairs, and the occurrence of the disease in other members of the family, will attract attention. In old-standing cases obscured by age or complications it is necessary to search thoroughly for the fungus, and to bear in mind the advice to be always on one's guard in the presence of a persistent, rebellious scalp-affection, simulating psoriasis, eczema, seborrhœa, and the *folliculites décalvantes*.

Treatment.—Appropriate measures are necessary to counteract any disturbance of the general health that may be present in favus. At the outset all favic and other crusts and accumulations should be thoroughly removed by the usual softening and cleansing methods, and the hair should be completely cut away, and kept so. Mild antiseptic dressings may then be applied, to subdue any inflammation, or heal excoriated surfaces. This accomplished, the further treatment is nearly identical with that for ordinary ringworm (*see* Tinea Tonsurans). Cases are often most rebellious. Favus of non-hairy parts is much more amenable. When the nails are affected it is necessary to remove mechanically as much of the diseased part as possible, and then thoroughly rub in, or keep the part soaked with, parasiticides.

T. Colcott Fox.

FEBRICULA (*febricula*, slight fever).—Synon.: Fr. *Fébricule*; Ger. *Febricula*.

Definition.—Simple fever, of one (*ephemera*) or not more than a few days' duration; not preceded by any one known invariable antecedent; and not attended by any one definite organic lesion.

It may well be doubted, however, whether such a thing as simple fever, in the strict sense of the term, exists; anyhow it must be one of the rarer forms of disease. The conditions which, from our necessarily imperfect knowledge, it is convenient to call febricula are numerous and of great practical importance. They may be somewhat roughly grouped as follows:—

1. Abortive or incomplete forms of some one or other of the specific continued fevers—namely, typhus, typhoid, or relapsing. The writer's own experience leaves no doubt in his mind that such irregular forms are met with during epidemics of these diseases.

2. Instances of some of the exanthemata, especially scarlatina and modified variola, in which the usual rash is either absent or so slight or brief as to pass unnoticed.

3. Intermittent fevers, in which for some reason or other the paroxysms do not recur, or only at uncertain and distant intervals.

4. Cases in which the local symptoms usually attending certain forms of fever are very slight or very obscure, and therefore difficult, perhaps impossible, to detect. Instances of this occur in connexion with tonsillitis, erysipelas, rheumatic fever, influenza, and tubercular disease.

5. Cases in which considerable febrile movement is present during the development of the primary as well as of the secondary symptoms of syphilis, and of which it is not easy to ascertain the real cause.

6. Fever as the consequence of exposure to a high external temperature—for instance, the *febris ardens* of tropical climates (Murchison); and of violent and prolonged muscular exertion.

7. Fever as the consequence of irritation of any organ or tissue, such as of the stomach by indigestible matter, of the colon by scybala; or of catarrh of a mucous surface—for example, urethral fever.

8. Certain ill-understood but not uncommon disorders of nervous centres, cerebral, spinal, or sympathetic, which are often followed by febrile movement.

Anatomical Characters.—Fever, however caused, which runs high, produces congestions and tissue-changes in the viscera, especially in the lungs; but, in view of the short duration of febricula, it would in most cases be impossible to decide whether any pathological changes found after death were the consequence or the cause of the febrile movement. It is possible, but not yet proved, that there may exist some contagion capable of producing febricula, and febricula only.

Symptoms.—Febricula is characterised by a rise of temperature, rarely exceeding 102·5° F., but sometimes, especially in cases due to exposure to heat, reaching 105° F. or even higher, although only for a short time. The access of fever may be gradual, or marked by slight rigors; and some or all of the common clinical symptoms of fever may be present in varying proportion and in greater or less degree, such as—general malaise; dry skin; frequent pulse, amounting to 100 or 120 per minute; tongue furred, with a more or less distinct, central, dry, reddish-brown streak; thirst, loss of appetite, and nausea; constipation; scanty, high-coloured urine; and headache, intolerance of light, slight deafness, restlessness, sleeplessness, and slight delirium at night.

Diagnosis.—The diagnosis of febricula rests upon the exclusion of all the other recognised kinds of idiopathic or of symptomatic fever. As a matter of practical diagnosis at the bedside, almost every disease attended by rise of temperature is now and then, at its outset, mistaken for febricula.

Prognosis.—The prognosis depends upon the degree and duration of the pyrexia, but in this country is almost always favourable.

Treatment.—In the absence of any special indication, rest in bed for a day or two, liquid food until the desire for solids returns, and, if constipation be a marked feature of the case, a moderate dose of some mild purgative, will be sufficient. It is, however, always prudent to remember that what seems to be febricula may be the beginning of some serious and perhaps highly infectious disease.

Cooling drinks, such as citrate of potassium in effervescence, liquor ammonii acetatis with a little spirit of nitrous æther; or nitro-hydrochloric or dilute nitric acid (one drachm to a pint of water) with some fresh lemon-juice added, may be given according as the one or the other is grateful to the patient. Anything like active treatment, except sponging the skin or the use of the cold or tepid bath in cases of heat-fever, is unnecessary, rarely does good, and is almost always positively injurious. J. Andrew.

FEBRIFUGES (*febris*, a fever; and *fugo*, I drive away).—Synon.: Antipyretics.

Definition.—External applications or internal remedies which tend to lower the bodily temperature, when it has been abnormally raised by the processes of fever.

Enumeration.—The principal febrifuges, given in the order of their activity, are:—Cold Baths; Cold Affusion or Wet Pack; Alcohol; Diaphoretics; Salicylic Acid and its Salts, Quinine, Digitalis, and Aconite; Salicin, Phenazone, Acetanilide; and Water and Diluents generally.

Action. — Following Professor Binz, we may divide febrifuges into two classes:—(1) those which directly withdraw heat from the fevered organism; and (2) those which lessen its production.

1. In the first division we must give the foremost place to cold baths, the cold pack, and cold sponging, which powerfully abstract caloric from the surface of the body, and rapidly cool down the blood. Diaphoretics and alcohol act more feebly in the same direction, by dilating the cutaneous arterioles, and thus allowing the mass of the circulating fluid to be effectually exposed to the chilling influence of the air. *See* Cold, Therapeutics of; and Diaphoretics.

2. Secondly, we have to consider those drugs which actually check the febrile condition itself, by diminishing oxidation, or by lessening the rapidity of the circulation through those parts of the body in which the increased tissue-change is taking place. It is probable that we must explain the antipyretic properties of such drugs as quinine by their specific influence over the germs on which malaria depends; and perhaps the progress of science may enable us in the near future to nip febrile processes in the bud, by paralysing or destroying the bacilli which may start the chain of morbid processes which raise the temperature and depress the powers of life. The free use of water tends to promote excretion, and thus to remove the products of oxidation. Blisters possibly act by causing contraction of the vessels in the inflamed part.

Uses.—Antipyretic treatment is not much adopted in this country as a matter of routine, holding as we do that temperatures raised within certain limits are not *per se* elements of danger, and that, even although we may effectually cool down our patient, the progress of the disease may go on quite unchecked. But prolonged fever causes excessive tissue-change and fatty degeneration of the heart; and when the thermometer registers 105° F., and still tends upwards, we know that dangerous limits are reached, and that as a rule life is not long sustained above 107° F. It then becomes our duty to interfere; and this is best done by plunging our patient into a bath at 95°, and gradually cooling it down to 65°. When the temperature descends to within 4° or 5° of the normal we remove him to bed, remembering the dilatation of vessels which must follow the contracting effect of cold, and the consequent cooling process which must continue to go on. Here, as in all febrile conditions, the thermometer is our surest guide, and we must be directed by it as to when to resume the treatment, for frequent repetition may be needed, and on the Continent as many as 200 baths have been given in the course of a single illness. Along with this the Germans combine the use of large doses of quinine; but, notwithstanding the marked tolerance of the drug under pyrexial conditions, the danger of perilous depression from such free medication is no imaginary one; and, putting ague apart, we find this valuable drug most beneficial in such fevers as seem to owe their origin to septic poisoning. Digitalis is not a powerful antipyretic, and in large doses is too disturbing to the heart, and too apt to produce gastric derangement, to inspire much confidence; but phenazone causes profuse perspiration, and is much used in febrile disorders on account of its certain and rapid action, and acetanilide is effectual in smaller doses. The influence of salicylic acid over acute rheumatism is remarkable, as it seldom fails to reduce temperature and relieve pain in forty-eight hours; but in other feverish conditions its beneficial action is by no means so well-marked. Salicin also has numerous advocates, who prefer it to the salicylates as being less depressing to the circulation. Iron is of value in erysipelas, and exerts some controlling power over acute rheumatism. Aconite and diaphoretics are of undoubted service in aiding the defervescence of some of the minor febrile disorders.

R. Farquharson.

FEIGNED DISEASES.—No insignificant part of the real difficulty in the practice of our profession depends on what we may call feigned diseases. The art of diagnosis consists in the power of recognising morbid conditions with skill and promptitude; and in proportion to the natural sharpness and well-digested experience of the medical man is his success in the discrimination of one symptom from another which resembles it more or less superficially. Many disorders possess a strong family likeness in their very early stages, whilst others may prove deceptive throughout their whole course; and if to this we add the efforts at deception occasionally resorted to by impostors, we see the caution which must of necessity be adopted by those who exercise their calling within wide limits. In considering, therefore, the subject of feigned diseases, a greater amount of order may attend our studies if we adopt the following simple classification:—

1. Those diseases which naturally resemble one another, and in the deception attending the diagnosis of which the patient has no share.

2. Those diseases which are also difficult of diagnosis, but in which the patient involuntarily deceives under some morbid nervous impulse.

3. Cases in which the patient sets himself deliberately and elaborately to deceive those around him.

1. Under this heading we may perhaps include the exanthemata and other acute feverish affections, which are confessedly difficult of diagnosis before the eruption or other marked points of difference are fully established. Important though it may be, in the case of public schools or large bodies of men, to act promptly in the face of such an emergency, the medical man will often feel himself compelled to postpone his decision; but he should at the same time act on the defensive by the timely exercise of quarantine and 'hygienic precautions. Some diseases, again, are difficult to distinguish from one another, even after their prodromata have passed away, and among these we may include small-pox and pustular syphilis, which occasionally cause more than a shade of suspicion to pass over the mind; whilst mild variola and severe varicella must always have too many points in common to render them otherwise than stumbling-blocks even to the initiated. Various forms of roseola may closely simulate measles; scabies is often hardly to be picked out from amongst the eruptions which its irritation causes; whilst throat-affections may apparently overlap each other and engender the idea of diphtheria where nothing more than superficial or aphthous ulceration really exists. But it is when the ailment under which our patient labours resembles something else during its whole career that mistakes are naturally most likely to arise. We are frequently shocked with some scandal in which the innocent victim of brain- or other organic disease has been consigned to a police-cell, and where the plea of drunkenness has been attempted to be sustained by the guardians of the public peace. So difficult is it to make a really trustworthy diagnosis between the coma of alcohol, of uræmia, of opium, and of certain apoplectic conditions, that the truly cautious and well-informed practitioner would prefer not to attempt to do so offhand. It is impossible to lay down any general rules, but we may remember that alcohol in poisonous doses lowers the temperature and dilates the pupil; that in uræmia an examination of the urine will put us in the right track; whereas opium will produce a contracted pupil; and in cerebral hæmorrhage some elevation of the body-heat may not improbably be observed.

But all these points may fail us from time to time, and we had best act at all times as though the case were really a serious one, and requiring treatment by all the best resources of the medical art.

A very little consideration will enable every experienced practitioner to recall other instances of this sort of natural mimicry: of the difficulty he must often have experienced in deciding between syphilitic and other brain-affections; of the close affinity between pulmonary consumption and dilatation of the bronchial tubes; of the resemblance between specific and malignant ulcerations; between various diseases of the testicle, the bladder, and the stomach, respectively. All these form part of the regular teaching of medicine and surgery, and will be found treated of elsewhere.

2. We must now consider the cases in which diseases are feigned, not by the direct action of the patient himself, but because he is unable to resist the vagaries of his weak and excitable nervous system.

Problems of the greatest complexity and difficulty are here presented to the medical man, and require for their due solution much tact and experience. Functional affections so closely simulate organic disease under these circumstances that suspicion is often completely disarmed, and treatment adopted the very opposite of that which would most probably prove curative. Hysteria, in its protean forms, supplies the greater number of these cases, and may very closely simulate a large variety, more especially, of neurotic conditions (*see* HYSTERIA). Paraplegia, incontinence of urine, joint-affections—in short, almost any disease which does not admit of palpable objective demonstration—may thus be feigned, and very severe treatment may even be adopted under the belief that real organic changes have to be met by the usually appropriate remedies. It is only necessary for us to refer thus briefly to these perplexing cases here; but it must always remain an interesting problem as to how the mechanism of causation here works, so to speak, and whether the patient actually suffers the acute pain of which she complains so forcibly. Sympathy, as we well know, however, is quite thrown away when dealing with these persons; and apparent roughness, with nervine tonics, and mental discipline, will often effect a cure, when the most elaborate combinations of other drugs ignominiously fail. A sudden shock, the pressure of poverty, or the absolute necessity for immediate exertion, will often effectually and permanently arouse the bedridden hypochondriac of many years, and restore him to his friends as a useful member of society; and we need never despair of success even under apparently hopeless circumstances. And although in minor measure the hypochondriac may fancy that every organ in succession is the seat of disease, and may even succeed in thus imposing on the unwary, the experienced practitioner will speedily detect the fiction, and be able to relieve the unhappy sufferer from the weight of his woes. *See* Neurasthenia.

But let it not be forgotten that 'expectant attention,' or the constant direction of the mind to the supposed morbid condition of any particular organ, may actually catch the unconscious deceiver in his own net by converting mere functional disturbance into organic disease.

3. To the third division of our subject can the term Feigned Diseases perhaps alone strictly be applied. Here we are met face to face with deliberate and premeditated imposture; and there is nothing for it but to match our own wits against those of the deceiver, and to thwart his native cunning by the superior sharpness of science. Now, there is nothing in the history of medicine more remarkable than the elaborate expedients adopted, and the amount of actual discomfort and suffering endured, by persons who have been desirous of escaping military or other duty. The exhaustive works of Gavin and Marshall, and Boisseau and others, give us details no less ingenious than interesting of these devices; but it is curious to note in how limited a range the more traditional modes of imposture seem to run, and how the same old stories are made to do duty over and over again. Thus we read of blindness, and deafness, and epilepsy, and paralysis being carefully imitated, and can hardly withhold our admiration from the astonishing tenacity with which the apparent symptoms were duly maintained. Incontinence of urine, dysentery, hæmoptysis, jaundice, and insanity were among the most favourite *rôles* in the repertoire; and ingenious as were the preparations for duly sustaining the part, no less ingenious were the means for detection, which usually proved successful. However carefully the impostor had studied his character, some little point was usually omitted. The yellow conjunctiva of jaundice can hardly be feigned; the incontinence of urine was generally found to be attended by an expulsive effort; the blood apparently proceeding from the lungs was by no means intimately mixed with the pulmonary mucus; the blindness, or the deafness, or the paralysis was not proof against some sudden shock or mental impression. Most of the cases so carefully described by writers on military medicine are now mere matter of history, and are hardly likely to occur again. And the reasons for this are twofold. First: the inducement for deception is practically gone. In former days, when the soldier's pay was small and his hygienic condition bad, discharge from the service as an invalid was eagerly prized as a means of escaping irksome duty; but matters have greatly changed for the better of late years. Not only are the emolument and the comfort of our army vastly increased, but short service and the reserve enable soldiers to retire early into civil life; whilst the abolition of bounty has removed the principal pecuniary inducement for frequent desertion and re-enlistment. It is now found much easier for a man simply to desert than to go through any elaborate process for the personification of disease. Again, the savage process of forcible impressment for naval service was naturally productive of many attempts to escape from the hard work and ferocious discipline of our men-of-war. Secondly: the progress of science and improved means of diagnosis have rendered the task of the impostor difficult, if not well-nigh hopeless. Feigned blindness can hardly resist the test of the ophthalmoscope; electricity will clear up many apparently anomalous nervous symptoms; the stethoscope and the sphygmograph will tell us the real condition of the heart; and careful observation will detect the rougher attempts to deceive. Again, malingering may often be exposed by examination under chloroform or ether. We are not likely now to be deceived by a piece of liver tied to the breast to simulate cancer, or by an artificial nasal polypus; but Mr. Gould records in the *Lancet* the case of a young woman sent to hospital for double buccal tumour, in whom on examination the swellings were found to consist of tightly wound balls of thread forcibly inserted between the teeth and the cheek. Mr. Anderson, of Richmond, fairly capped this in a subsequent number by narrating the vagaries of a schoolgirl who had produced a state bordering on gangrene of the hand by a ligature of ribbon resolutely applied to the forearm; and it is evident that although skin-diseases and ulcerations may be made or kept up by local applications, we only require a suspicion to cross our minds to put us on the right track for discovery.

We are not, however, to suppose that all attempts at deception have finally passed away, that feigned diseases are now things of the past. Anyone whose practice lies among prisoners, or soldiers, or schoolboys, or the sufferers from railway accidents, will very soon be convinced to the contrary (*see* Railway Injuries). Experience, however, will speedily show him who the schemers are, and enable him to circumvent their endeavours; and the range of symptoms simulated will soon be found to be singularly narrow. Subjective sensations are, of course, very difficult to detect; and if a headache, or pain in the back or leg or arm, be complained of by the sufferer, real or assumed, we may often find it best for our own reputation to give him the benefit of the doubt. Whilst proceeding, therefore, with due caution, the practitioner must endeavour to hold the balance between an excess of suspicion and a too credulous attitude, remembering that the good of society and of the public service must be fairly considered, whilst all care must be taken not to confound the innocent with the guilty in dealing with disorders which ingenuity has occasionally been enabled to feign. ROBERT FARQUHARSON.

FEIGNED INSANITY. — *See* INSANITY, Varieties of.

FESTER.—A superficial suppuration, resulting from irritation of the skin; the pus being developed in vesicles of irregular figure and extent. The suppurating inflammation caused by a thorn or splinter of wood forced into the flesh is a common example of a fester.

FEVER (*ferveo*, I am hot).—SYNON.: Pyrexia; Fr. *Fièvre*; Ger. *Fieber*.

DEFINITION.—One of the most remarkable facts in connexion with disease is the rise of temperature which is attendant upon almost every disturbance to which the body is subjected. The rise of the temperature of the body, when it attains a certain height, and lasts a certain time, is called Fever; and is accompanied by derangement of function, attributable to the febrile condition itself, and in a measure independent of the initial cause.

GENERAL CONSIDERATIONS.—Fever plays so important a part in acute disease generally, is accepted so universally as a mark of the severity of the disease, and so often presents itself as apparently the chief antagonist with which the physician or surgeon has to contend, that the attempt to penetrate the secret of its essential nature has always been a favourite task, and every school in every age has had its theory of the febrile process. It is only, however, within comparatively few years that exact measurement of the body-heat by the clinical thermometer, combined with chemical examination of the various excretions at different temperatures, and aided by the experimental method of investigation, has furnished the data for such a theory (*see* THERMOMETER). A minute description of fever in the abstract, distinguishing, as would be required, between phenomena proper to fever and phenomena due to the condition or lesion on which the fever depended, would be lengthy, and so crowded with qualifications and exceptions as to be vague and unsatisfactory. The attempt, indeed, would have a more radical defect. Either some variety of fever must be taken as a type to which other forms are referred, which is vicious in principle; or all the phenomena of all febrile conditions must be enumerated and classified, which would confound the accidental with the essential, and would result in a heterogeneous collection of facts without due relation among themselves.

A mere outline therefore will be given of the principal deviations from normal functional action observed in fever, and the space set apart for the subject will be reserved chiefly for an exposition of what is known of the nature of the febrile process.

DESCRIPTION.—In every attack of fever there are traceable the three stages of invasion, domination, and decline, with or without an antecedent period of incubation. They may all be run through in the course of a few hours, as in a paroxysm of ague, or they may extend over weeks.

The period of invasion is characterised by a rising internal temperature, while the surface may remain cold and pale, the patient feeling chilly and suffering from rigors or shivering; the pulse is frequent, but generally small and long, from contraction of the arteries. During the dominance of fever the temperature remains high, the skin is hot, and the shiverings are replaced by a subjective sense of heat; the pulse is now large and bounding from relaxation of the arterial wall. The decline is indicated by a falling temperature, a softer and less frequent pulse, and by a return towards normal conditions generally; it may be initiated or accompanied by a critical sweat or other evacuation. Death may take place at any period of the disease.

Taking the temperature as the index of the duration and character of each stage, we may find it in the first stage rising abruptly or gradually, continuously or with remissions. If the invasion extends over several days as in enteric fever, nocturnal exacerbations and morning remissions are, as a rule, observed. A rapid rise of temperature is usually continuous, or nearly so. When the opportunity occurs of making the observation, as in intermittent or relapsing fever, or when fever is experimentally induced in animals, or in man by surgical operation or accidental septic inoculation, the increased heat is found to be the initial phenomenon, preceding the rigors and all other symptoms.

The end of the period of invasion, and the setting in of the stage of dominance, is more distinctly marked by the change in the character of the pulse, and by the determination of blood to the surface, together with the substitution of the subjective sensation of heat for that of cold, than by the thermometer.

During the dominant stage the temperature remains at, or oscillates about, a given point, and the fever is considered to be moderate if the morning temperature is 102° F. or under, and the evening not above 103°; to be high when it ranges between 103° in the morning and 104° in the evening; and to be severe when these limits are exceeded; while, with rare exceptions, a temperature of 106° indicates great danger. As the stage advances, the heat may gradually rise or fall; the oscillations being slight or considerable, and at times irregular and extreme. Except when the fever is due to local inflammation, or to continual entry into the blood of morbid particles or fluids, the duration of the dominance is usually in proportion to the time occupied by the invasion.

The decline again is generally abrupt, and has the character of a *crisis* when the invasion has been rapid, and is protracted when it has been gradual.

A fatal termination may be ushered in by hyperpyrexia; more commonly the temperature falls below the normal point and there is collapse.

The pulse is always increased in frequency by fever, but while during the height of the disease there is usually some relation between the body-heat and the pulse-rate, the pulse is often extremely frequent before the temperature has reached its height during the invasion, and it does not in all cases fall with it *pari passu* in the decline. The different stages are marked rather by differences in the character of the pulse than in its rapidity; during the period of invasion the arteries are more or less in spasm, and the pulse is small and long; during the dominance, with certain exceptions, the arterial walls relax, the vessels are large, and the pulse sudden, short, and dicrotous; as the fever declines, the arteries are still further relaxed, but the action of the heart is less powerful, so that the pulse becomes softer.

Respiration is frequent, following as a rule the pulse; the amount of carbonic acid expired is greatly increased.

The tongue is generally more or less furred, its appearance varying with the degree and kind of fever and with its cause. It becomes brown and dry, or unnaturally red, in protracted and adynamic fever, when the teeth and lips may also be coated with sordes. There are almost always thirst and loss of appetite. The bowels are usually confined.

The secretions are all more or less modified. The perspiration may be greatly increased, as in acute rheumatism; more commonly it is checked, causing the skin to be dry and burning. The amount of urine will vary to a certain extent inversely with the amount of perspiration; but the tendency is to increase, and the solid organic matters—urea and other nitrogenised substances—are always considerably augmented in quantity. The chloride of sodium, on the contrary, is diminished.

The characteristic nervous phenomena of the stage of invasion are rigors, which may be slight, and represented only by shivering or chilly sensations, or, on the other hand, may be intensified to convulsion. Severe headache is more common at this period than in the later stage, and there is usually considerable depression. When the fever has reached its height the rigors will have ceased, and there may be little or much delirium according to the severity of the attack, the idiosyncrasy of the patient, or the kind of disease giving rise to the fever.

PATHOLOGY.—The description of the febrile state has been abbreviated in order to leave place for a discussion of the nature and cause of the febrile process.

This will be facilitated by a brief reference to the production and regulation of the heat of the body in health, and would be comparatively easy had physiologists arrived at a complete and satisfactory solution of this problem. In the normal state the main source of animal heat is blood- and tissue-combustion. It may perhaps be well to say here once for all that the terms 'combustion' and 'oxidation' are employed as conveniently short expressions for the disintegration of complex chemical and structural molecules by which heat is liberated, and not to convey the idea of direct combination of oxygen with the carbon and hydrogen of the blood and tissues. Another very slight and unimportant cause will be obstructed motion of the blood in the capillaries: of direct conversion of nerve-force into heat we know nothing definite. The interesting and difficult part of the question is that which relates to the regulation of the temperature. It has been found that the changes which evolve heat are most active in muscle, in the nervous structures, and in the abdominal viscera; while in the lungs any combustion which may take place is not more than will counteract the loss of heat by evaporation and by the expired air. The skin, on the other hand, is the great cooling agent; there is little combustion of its structures, and it is continually losing heat by conduction when the surrounding temperature is low, but still more abundantly by evaporation under all conditions of external temperature. Heat is thus abstracted from the blood circulating in, and immediately beneath, the skin. At first sight, then, it would seem that the mechanism by which the temperature is regulated was extremely simple, and that it was to be found in the vaso-motor system of nerves. There being an internal heat-producing mass of tissue, and an external refrigerating surface, in order to raise the temperature, the arterioles of the skin are contracted, shutting off the blood, while those of the deeper structures are relaxed, allowing it to reach them in greater abundance; in this way a double influence is exerted—less heat is lost by the skin, and more is produced in the muscles and other internal parts. Conversely, the temperature would be lowered by flushing the skin with blood—which would thus be exposed to cooling influences—and diverting it from the heat-forming, deep-seated structures. This explanation, however, is inadequate. It is true that the distribution of the blood, superficially or deeply, by means of the vaso-motor nervous system, contributes largely to the regulation of the temperature; but heat-production in muscle or gland is not directly proportionate simply to the amount of blood circulating through it. Tissue-combustion, and consequent evolution of heat, is excited or repressed by cerebro-spinal nerves which do not govern the arteries. The nervous stimulus which excites contraction in muscles determines in them at the same time evolution of heat, and this heat-production under nerve influence may be excited independently of contraction. The nervous system thus intervenes directly in heat-production chiefly by its action on the muscles, as well as indirectly through its influence on the circulation. This is not the place to discuss the question whether there are special thermal nerves and centres, but it seems probable that the muscles as thermogenic and as motor agents are under the control of the same central nervous mechanism.

Taking the increased heat as the characteristic of fever, the first question which arises is whether this is due to increased production of heat, or to diminished loss. While the diminished circulation in the skin, in the early stage, will obviously tend to retain heat within the body, there is now no room for doubt that there is increased heat-production. The temperature rises in spite of profuse perspiration, when, of course, heat is very rapidly lost, as in acute rheumatism, or when perspiration has been induced by jaborandi before a paroxysm of ague (Ringer); and it has been shown by direct experiment that in fever a man raises the temperature of a given quantity of water in which he is immersed more quickly, and to a higher point, than in health (Liebermeister). It is unnecessary to give other proofs or further refutation of the hypotheses which explain the heat of fever solely by diminished escape of heat from the body.

It may further be taken as certain that the immediate cause of the increased generation of heat is increased blood- and tissue-oxidation. This is shown by the increased products of combustion given off in the different excretions. The febrile elevation of temperature is attended at once by increase in the amount of carbonic acid expired. This is more marked during the rise than when the heat has attained its maximum, because the increasing temperature expels the gases of the blood, and the greater rapidity of the circulation sends the blood more freely and quickly through the lungs, and exposes it more to the air. At first there will thus be eliminated not only the carbonic acid formed under the influence of the febrile process, but that which was held in solution by the cooler blood, and is driven off as its temperature rises; when the expulsion of dissolved carbonic acid is completed, the amount excreted will be diminished by so much, but it still remains larger than at the normal temperature.

A similar indication of increased tissue-combustion is furnished by the urine. The amount of urea is usually absolutely increased, notwithstanding a diminished consumption of nitrogenised food; or if the urea itself is not excreted in larger quantity, there is more nitrogenised waste in other forms. The total of nitrogenised matter contained in the urine is always augmented by fever.

While, however, the products of combustion show that rapid metabolism is going on, it is not clear that it is adequate to account for the whole of the heat evolved; and Dr. Ord has advanced the luminous hypothesis that the energy normally absorbed by the constructive operations taking place in the tissues is set free through the suspension of these processes by fever, and takes the form of heat.

The real difficulty of the problem arises when we inquire what is the cause of the increased tissue-combustion, and especially how the febrile heat is regulated. It has been already stated that the distribution of the blood to the deep structures and organs and to the skin respectively is not a sufficient explanation of the physiological balance of heat; but it might be supposed that the greater rapidity of the circulation in fever, renewing the supply of oxygenated blood within the structures more frequently and more freely, would account for the greater oxidation. The rise of temperature, however, is not in proportion to the flow of blood through the vessels, and hyperpyrexia is often coincident with a failing circulation, the heat of the body, indeed, apparently in some cases actually increasing after death.

Dr. Donald MacAlister has done much to elucidate the entire question in his Gulstonian Lectures, by bringing out more distinctly the thermogenic function of the muscles, and the thermotaxic or heat-regulating power of the nervous system, which operates through its influence upon thermogenesis in the muscles on the one hand, and upon the thermolytic action of the skin on the other.

One step towards the solution which may be considered certain is that the nervous system is concerned in the maintenance of the heat of fever. Each disease has its own characteristic range and variations of temperature; and this fact alone, that febrile heat is not vague and irregular, but that there is the substitution of a morbid for a normal balance, is evidence of nervous control. Numerous observed facts and experiments point to the same conclusion.

Another item of positive knowledge obtained by experiment is that pyrexia may be excited by the introduction into the blood of septic or other matters, which, it is important to note, need not be particulate, but may be diffusible fluid. The increased heat may therefore be independent of capillary embolisms, and of bacteroid or other organisms.

Now in disease or after injuries we have almost always both causes in possible operation—an impression on the nervous system, and the entry of altered organic matters into the blood. In endeavouring to assign prominence to one or other, we have, on the one hand, such facts as the hyperpyrexia of cerebral lesions, which cannot be due to blood-contamination, and, on the other, the teachings of antiseptic surgery, which demonstrate that absorption of putrescent discharges is the great cause of surgical fever. It still remains to be determined whether the presence in the blood of foreign matters gives rise directly to increased activity of oxidation, or whether the poison, as we may call it, produces this result through its action on the nervous system, either by affecting the nerve-centres themselves, or by producing irritation in the capillaries, which is carried to the nerve-centres, and reflected along efferent nerves. In the present state of our knowledge this question cannot be definitely settled.

If a theory of the febrile process is to be formed, it must be based upon a theory of the relation between the nervous system and the processes of nutrition and oxidation, and especially the latter. Numerous facts of disease and of experiment point to the conclusion that the circulation of duly oxygenated blood through the tissues at the usual rate would, without some check to oxidation, result in more rapid tissue-change, and the production of a higher temperature than the established norm. The restraining power is supplied by the nervous system, the loss of this influence being illustrated in hyperpyrexia. The mode in which the nervous system acts may be represented as being through the tension maintained in the nerve-centres. All nervous actions have the character of phenomena of tension, and the tension generated in the cells is sustained in the nerve-fibres to their peripheral terminations, where they are merged in the structures, and so blended with them that all nutritive and oxidative changes are common to the nerve-endings and the tissues in which they end. If we suppose that the nerve-tension can modify chemical action, as can electrical tension or thermal conditions, and that, *vice versâ*, the nutritive and oxidation changes in the tissues can influence the tension of the nervous structures, we can represent to ourselves the interaction between the nervous system and the blood and tissues in the febrile process. When from disease or injury of the great nerve-centres their power of maintaining tension is lessened or abolished, and their influence proportionately diminished, so that the affinities of the blood and tissues have unrestricted play, the result is hyperoxidation and pyrexia. When, on the other hand, septic matters or other substances are introduced into the blood, acting as ferments or in some other way, they increase oxidation, and directly raise the temperature, overpowering the restraining influence of the nerves until this is reinforced, which may possibly occur through increased evolution of energy, resulting from the increased activity of metamorphosis. We cannot, however, here develop or fully elaborate this hypothesis.

Treatment.—The treatment of fever is of course primarily directed to the removal of the cause on which it depends, but together with the measures adapted to this end are usually employed means for the moderation of the febrile process as such, and these may at times take the first place. We can do little more than mention the more important of them, taking first what may be called the general methods, and premising that rest in bed, simple food, &c., are assumed to be understood. Venesection is now scarcely ever practised as a means of combating fever. Purgatives are often useful, as are also diaphoretic and diuretic salines, with abundance of water to drink, either alone or in the form of some agreeable *tisane*. Free action of the secretions, which is the object of these remedies, is of service in removing the increased products of oxidation, the water taken co-operating by acting as a solvent and vehicle; and it is possible that medicines which promote this activity may directly bring down the temperature. When, for example, perspiration has been induced, a coincident fall of temperature may be due more to some change antecedent to the perspiration, than to the loss of heat by transpiration and evaporation.

Of special measures for the reduction of febrile heat when this is becoming dangerous, either from its intensity or duration, the first to be mentioned is the cool or cold bath. This should be resorted to in all cases of hyperpyrexia, from whatever cause; its efficacy, first established in the high temperature of acute rheumatism and enteric fever, has been proved also in cases of septic hyperpyrexia after ovariotomy, and even in injuries to the brain. Here the water may be positively cold. When the bath is employed to control temperature, not dangerous from its height, but from its duration, as in enteric fever, the temperature need not be lower than 70° or 65° F. An ice-cap devised by Mr. Knowsley Thornton, for applying cold of 32° to the entire head, has been found useful in hyperpyrexia following ovariotomy.

Many substances have the property of reducing febrile temperatures when taken in large doses. Among the most powerful are the complex bodies recently introduced, phenazone, acetanilide, exalgin, and others of the same class. Their influence on febrile heat is undoubted, and it may be exerted favourably in the early stage of sharp fever from whatever cause, but their continued use is attended with danger. The lowering of the temperature may be dearly purchased at the expense of the patient's strength. Another powerful agent often employed to combat fever is quinine. When given for this purpose, it is administered in doses of from ten to twenty or even thirty grains once in twenty-four or forty-eight hours; or three to six grains of the neutral sulphate may be injected under the skin. Salicylic acid has a remarkable influence on the temperature in acute rheumatism, and some effect, though far less marked, in fever from other causes. It may be added that when pericarditis has come on in rheumatic fever, this drug usually altogether fails to influence the temperature. The only other drug which need be specially mentioned is aconite, the mode of action of which is totally different from that of quinine, and of which it may almost be said that it antagonises the fever process rather than reduces temperature; its most marked influence being on the force of the heart and the contraction of the arteries. The opportunity for the manifestation of its powers occurs in the early stage of catarrhal fever, the result of chill. Given in frequent small doses (a drop or two of the tincture every five minutes till twenty minims or half a drachm has been taken) when the temperature is rising, the pulse frequent and hard, with headache and burning skin, the effects are often striking. When a local inflammation is established, it is no longer of much use; and when the fever is protracted, as in enteric fever, or when there is pneumonia, it may be dangerous, from its depressant influence on the heart. *See* ANTIPYRETICS.

W. H. BROADBENT.

FIBRILLATION, Muscular. — A localised quivering or flickering of muscular fibres. *See* MOTILITY, Disorders of.

FIBRINOUS CLOT.—*See* CLOT.

FIBRINOUS CONCRETION.—*See* CONCRETION.

FIBROID DEGENERATION. — A morbid change which consists in the substitution of a tissue somewhat resembling fibrous tissue for other structural elements; some pathologists consider this change to be of the nature of a degeneration. *See* DEGENERATION; and CIRRHOSIS.

FIBROID PHTHISIS. — A name given to certain cases of phthisis in which a considerable development of fibroid tissue occurs in the lungs. *See* PHTHISIS.

FIBROMA.—A form of tumour composed of fibrous tissue. *See* TUMOURS.

FIBRO-PLASTIC GROWTH. — A form of new-growth, composed of fibro-plastic elements. *See* TUMOURS.

FICUS UNGUIUM (*ficus*, a fig; *unguis*, a nail).—A disease of the posterior wall of the nail. *See* NAILS, Diseases of.

FIDERIS, in Switzerland.—Chalybeate waters. *See* MINERAL WATERS.

FIFTH NERVE, Diseases of.—The fifth or trifacial nerve (*nervus trigeminus*), the largest of the cranial nerves, consists of a motor and sensory portion, the sensory fibres passing through the Gasserian ganglion, and being distributed to the face and a portion of the head. The motor portion, much the smaller, is physiologically independent of the ganglion, and supplies the pterygoid, masseter, buccinator, and temporal muscles. The two first divisions—the ophthalmic and superior maxillary—are entirely sensory, and proceed from the ganglion. The third or inferior maxillary division proceeds also from the ganglion, but receives besides the whole of the motor root. Lesions of this nerve cause disorders of sensation, motion, and nutrition or secretion, according to the anatomical position and extent of the injury.

The affections of the fifth nerve may be considered in the following order:—

1. **Trifacial Neuralgia.** — Neuralgia may affect one or all of the three divisions of the nerve. It is fully described under the head of tic-douloureux. *See* TIC-DOULOUREUX.

2. **Trifacial Anæsthesia.**—Anæsthesia of the trigeminus, usually unilateral, may be dependent either upon (*a*) *central lesion*; or upon (*b*) *peripheral lesion.*

(*a*) *Central lesion.* — Hemiplegia from hæmorrhage, softening from thrombosis, tumour, or other coarse affection of the intracranial nervous system, is usually accompanied by some anæsthesia in the district supplied by the trigeminus, arising probably from interference with the integrity of the fibres of origin of the nerve in their central course. The anæsthesia usually occurs on the same side of the body as the paralysis of motion, and therefore opposite to the seat of lesion. This is always the case when the lesion occupies a position above the pons Varolii. In disease of the pons Varolii, however, the loss of sensibility may involve both halves of the face, although it usually affects the same side as that upon which the limbs are paralysed, and opposite that upon which the portio dura and sixth nerves (when either or both of them are involved) are affected. In cases of apoplexy, the anæsthesia is usually very imperfect, and not sharply defined. It is short-lived, lasting from a few hours to days; but in certain cases it may continue, and even outlive the motor paralysis with which it is conjoined.

Intracranial tumours may produce more persistent anæsthesia, either by immediate destruction of sensory fibres, or, indirectly, by the cerebral enlargement, due to their growth, causing compression of the fifth nerve as it traverses the floor of the skull.

(*b*) *Peripheral lesion.*—Anæsthesia dependent upon lesion of the trigeminus in its peripheral course is a symptom of serious moment, which it is important to distinguish from that of central origin; and this may be accomplished by noting the following points: The degree of peripheral anæsthesia far exceeds that which obtains in cases owing their origin to a central cause. It is much more complete, and may involve, which the latter does not, trophic and vaso-motor complications. Its extent varies according as the trunk of the nerve, including the Gasserian ganglion, is involved; or only one or two of its branches. Should the main trunk be affected, there is more or less complete anæsthesia of one side of the face and part of the ear, conjunctiva, cornea, nostril, mouth, half the tongue, the gums on the same side, and a part of the palate. If the conjunctiva be touched with the finger, there is no reflex contraction of the eyelids. A glass from which the patient drinks seems to him as though it were broken, for he feels the material on the sound side and not on the affected side. The skin of the face is cool, and may be somewhat œdematous, and purplish in tint. After a few days, if the cause persists, the eye on that side looks dry, glazed, and congested; the cornea becomes cloudy, and in time sloughs and perforates, the contents of the eyeball escaping to a varying extent, so that the organ is destroyed. There is dryness of the nostril on the affected side, and irritant substances applied to it fail to produce sneezing. Taste is lost on that side of the tongue, except at the base, which is supplied by the glosso-pharyngeal nerve. The salivary secretion is diminished. In time there may be bleeding from the gums and ulceration of the mucous membrane. Should the lesion exist upon one of the three divisions of the trigeminus, the anæsthesia will be found sharply limited to the district supplied by that division.

The nature of the lesion must be determined by the examination of concomitant conditions. It may consist either in caries of the bone, tumour, aneurysm, or meningitis, acute or chronic. Whatever be the active cause by which the nerve is damaged, the effects will be the same: pressure upon, and disorganisation of the nerve-fibres will result in the disorders described—sensory, motor, trophic, and vaso-motor. In such circumstances, one or more of the other cranial nerves are usually affected coincidently. In tubercular meningitis, the fifth nerve is shown to be paralysed (along with others traversing the floor of the skull) by the conjunctivitis and corneitis so often present in advanced stages of the disease. Should the condition accompany bulbar paralysis, the lesion must be referred to the nuclei of origin of the nerve in the medulla oblongata.

TREATMENT.—Syphilitic gummata on the floor of the skull, developed either in the membranes of the brain or in the nerve itself, are so frequently the cause of the disorganisation of the fifth nerve which gives rise to anæsthesia, that in all cases it is right—unless some other explanation is evident beyond all doubt—to bear in mind the possibility of such a cause, and to prescribe accordingly without delay. From 10 to 20 grains, or more, of iodide of potassium should be administered every four hours. Should there be a gumma pressing upon the trunk of the nerve, this treatment will probably have the effect of bringing about a rapid amelioration, and, in many cases, supposing it has been applied early enough, a complete cure. It is evident that, as regards other causes, there is no particular indication for treatment, which must be adapted to the special circumstances of the case.

3. **Trifacial Hyperalgesia.**—Hyperalgesia may accompany or precede neuralgia of the fifth nerve. It may also precede facial anæsthesia when this is due to neuritis. There are varieties in the degree of this hyperalgesia. It is sometimes so severe that the slightest touch occasions pain. The face cannot then be washed in the ordinary way, but the patient has to take a piece of sponge or wetted rag and cautiously dab the skin with it. Sometimes it is described as a feeling of soreness only when the hand is passed over the face. In either case the condition is accompanied by diminution of the tactile discrimination in the part. In *mimetic spasm* of the portio dura, there is often hyperalgesia in the region of one or more divisions of the fifth, and the lesion is then doubtless connected with the deep origin of this nerve. In blepharospasm it will often be found, if the face be carefully examined, that pressure with the finger at some point will check the spasm. Subcutaneous division of a twig of the fifth (or afferent nerve) at this point will often bring about a cure of the affection. The supra-orbital or subcutaneous malar are the nerves most commonly in fault.

Photophobia is referable to hyperalgesia of the branches distributed to the conjunctiva.

4. **Motor Disorders.**—Affections of the motor root of the fifth nerve are either (*a*) of a *spasmodic*; or (*b*) of a *paralytic* character.

(*a*) *Spasm.*—Spasm of the muscles supplied by the trigeminal nerve may be tonic or clonic. In trismus, or 'locked jaw,' the teeth are clenched together by the tonic contraction of the masticatory muscles, which can be felt tense to the touch. According as the muscles are involved generally, or only partially, the lower jaw will be fixed in a symmetrical position, or be pulled over to one side, or advanced or receded. Clonic spasm of the same muscles is observed in various convulsive disorders; and slower movements of a horizontal character constitute the grinding of teeth sometimes indicative of cerebral disease.

Trismus may either be one symptom of tetanus (*see* TETANUS), or it may occur by itself, and then it either arises from cold, or is of reflex origin, from irritation of the sensory portion of the nerve by decayed teeth, dentition, or disease of the jawbone. It may be due to the presence of a foreign body, possibly of very small size, lodged in the cicatrix of a wound upon the face, or even in some distant part of the body. Irritation from worms is a possible cause. It is still more commonly hysterical.

TREATMENT.—When arising from cold, the constant current should be applied to the contracted muscles. Any source of irritation, whether from decayed teeth, or otherwise, must be sought for, and, if possible, removed or remedied.

The removal of a foreign body will sometimes bring about an immediate cure. This failing, the hypodermic injection of morphine, in doses of gr. $\frac{1}{6}$, may be employed, and bromide of potassium given internally in doses of 20 grains. When the presence of worms is suspected, appropriate treatment must be employed. If the affection be hysterical, somewhat powerful faradic currents, directed to the muscles of the jaw, will scarcely ever fail to open the mouth and cure the ailment. Hysterical trismus cannot be mistaken for dislocation of the jaw, if it be remembered that in the latter accident the jaw is fixed with the mouth partly open.

(*b*) *Paralysis.*—Paralysis of the masticatory muscles is not very common, but may be observed sometimes in cases of bulbar paralysis, or it may accompany anæsthesia of the face, and depend upon tumour, abscess, aneurysm, or some such coarse disease encroaching upon the trunk of the nerve within the cranium. To test the state of the muscles, the patient should be asked to move his jaw to and fro laterally, as well as in opening and shutting the mouth. Any irregularity of movement will be evident to the eye, and defective strength or absence of contraction in the affected muscles may be felt by placing a hand on each cheek, whilst the patient performs movements of mastication. When the jaw is found to fail in being carried to one side in a munching movement, the fault of course lies with the pterygoid muscles of the *opposite* side. The affection is more often unilateral than bilateral. Its importance is bound up with that of the lesion which gives rise to it.

As in peripheral affections of the sensory portion of the nerve, especial attention should be paid to the causation, and if this probably depends upon a tumour, the possibility of its syphilitic character should be borne in mind, and iodide of potassium administered in doses of from 10 to 20 grains, or more. If these measures fail, the question of surgical operation may have to be entertained. *See* NEURALGIA; and TIC-DOULOUREUX.

T. BUZZARD.

FILARIA (*filum*, a thread).—A genus of nematode worms, not very clearly defined, but which contains a variety of thread-like parasites whose body is of uniform thickness throughout, and at least fifty times longer than it is broad. Under this head are often included several human parasites, such as the *Dracunculus*, or Guinea-worm (*Filaria medinensis*), and the lung strongle (*F. bronchialis*), in addition to a variety of larval or sexually immature nematodes, whose genetic relations are only very imperfectly understood. In the latter category may be placed Bristowe and Rainey's entozoon (*F. trachealis*); von Nordmann's eye-worm (*F. oculi-humani* or *F. lentis*); the *loa*, infesting the eyes of the Angola coast and Gaboon negroes (*F. loa*); and, lastly, the nematode hæmatozoon (*F. sanguinis-hominis*) described by the late Dr. Timothy Lewis. It may be doubted if any of the above-mentioned parasites ought to be included in the genus *Filaria*, as understood by modern helminthologists, but, practically, it is still found convenient thus to speak of them. The Dracunculus will be found described under ENTOZOA; whilst the microscopic nematode infesting the blood will be found noticed under the articles CHYLURIA, and FILARIA SANGUINIS HOMINIS.

T. S. COBBOLD.

FILARIA SANGUINIS HOMINIS. This name was applied by Lewis to the embryo filaria which he discovered in human blood in 1872; and so long as no other similar parasite was found to have its habitat in the circulation, the name was appropriate. Recently, however, the writer has pointed out that the blood of certain Africans is liable to be infested by the embryos of two additional species of filaria; it therefore becomes necessary to modify Lewis's original name. Observation has shown that the filaria of Lewis appears in the blood only at night, disappearing from it during the day: whereas, of the two recently discovered species, one of them appears in the blood during the day only, disappearing from it at night; the other, in those individuals in which it occurs, is present in the circulation both during the day and during the night. Taking these facts as a basis for nomenclature, the writer proposes to name the three species—

Filaria sanguinis hominis diurna.
Filaria sanguinis hominis nocturna.
Filaria sanguinis hominis perstans.

Methods of demonstrating filaria embryos in the blood.—Blood is obtained in the usual way from a finger-tip; but in looking for filariæ, the respective habits of the different species must be borne in mind. Thus, if search is to be made for filaria sanguinis hominis diurna, the blood should be drawn between the hours of 11 A.M. and 6 P.M.; if for filaria sanguinis hominis nocturna, between 9 P.M. and 6 A.M.; if for filaria sanguinis hominis perstans, it may be drawn at any hour of the day or night.

To study the movements of the filariæ, ordinary preparations of freshly drawn blood must be used; but to warrant a positive opinion as to the absence or presence of embryos in the circulation, and for purposes of enumeration, a larger quantity of blood than can be dealt with rapidly in the ordinary way must be searched. The following is a good plan. Spread about half a drop of blood on a slide in a uniform layer over an area about 1″ by 1″, and allow it to dry. The slide may be stained and examined at once, or stored away till such time as may suit the observer's convenience. All that is necessary to demonstrate the filariæ in such slides, no matter how old they are, is to immerse them for two hours in a half-per-cent. solution of eosin, or a weak solution of fuchsin (one drop of the saturated alcoholic solution in an ounce of water), then wash them in one or two waters, and mount in Farrant's solution or glycerine jelly. So prepared, the filariæ and white blood-corpuscles are stained, whilst the colour of the red blood-corpuscles is discharged. To demonstrate the sheath, shape, and structure of the filariæ, make a thin film of blood by applying a clean slide over another slide having a droplet of fresh fluid blood on it; after allowing the blood to spread out between the slides, rapidly glido or pull them apart; immediately invert the slides over a capsule containing a few drops of acetic acid until they are dry; then immerse them in a half-per-cent. solution of eosin for two minutes, wash thoroughly, dry slowly, and mount in balsam. So prepared, the filariæ and leucocytes show pearly-white, whilst the red blood-cells are deeply, and the liquor sanguinis is lightly, stained by the eosin.

No matter how prepared, the slides ought to be scrutinised in the first instance with a very low objective—an inch is sufficient—and every part of them examined. A quick-travelling mechanical stage is of great assistance in this, and ensures thoroughness. When a filaria is found it can be centred and examined with a quarter-inch or higher objective; but it must not be forgotten that, in the first instance, only very low powers are suitable for searching.

The three species of embryo filariæ sanguinis hominis closely resemble each other. As seen in recently drawn blood, they are long, slender, gracefully formed, transparent, colourless, snake-shaped organisms, which for hours continue in a state of great activity, wriggling and twisting about on the slide like a wounded earth-worm, or an eel on a hook. After a time movement gradually slows down; but by a little management in preventing drying of the slide, the parasites can be kept alive for five or six days. In none of them can anything like an alimentary canal, or any definite internal structure, be made out.

As far as is at present known, the points of contrast in the three species are as follows:—

1. *Filaria sanguinis hominis diurna* (fig. 51).—The free hæmatozoal embryo of a species of filaria, the mature form of which is still unknown. Excepting that it enters the circulation during the day, this blood-worm resembles very closely in size, form, and habit the now familiar filaria sanguinis hominis nocturna of Lewis. The peculiarity in periodicity referred to is, doubtless, an adaptation to the habits of its unknown intermediary host. There is some reason for supposing that the filaria loa—a parasite living in the connective tissues, and sometimes showing itself underneath the conjunctiva in negroes—is the mature form of filaria sanguinis hominis diurna; for the geographical distribution of both, as far as our knowledge of this extends, is the same, and the undoubted embryo of filaria loa resembles filaria sanguinis hominis diurna in shape, and possibly in size; and, moreover, a patient of the writer's, who had at one time a filaria loa under his conjunctiva, has now the filaria sanguinis hominis diurna in abundance in his blood. The parasite seems to be confined to the tropical zone of Africa, more especially to the west coast. Future observation is likely to show that a large proportion of the inhabitants of these districts are affected with these worms, and it is likely that in a proportion of instances some pathological condition may be traced to them. As yet our information on these points is much too fragmentary to warrant even speculation.

2. *Filaria sanguinis hominis nocturna* (fig. 52).—The free hæmotozoal embryo of filaria Bancrofti. We owe the first notice of this parasite to Demarquay, who, in 1863, found numerous specimens of what, considering the circumstances of the case, must have been filaria sanguinis hominis nocturna, in the contents of a lymphous tumour of the thigh.[1] Later, in 1869, Wucherer in Bahia, and, quite independently, in 1870, Lewis in Calcutta, found the same parasite in chylous urine. It was not, however, until 1872, when Lewis showed that the normal habitat of this embryo worm was the human blood, that the discovery excited much interest. Since that date the significance of this parasite as a factor in tropical pathology has gradually come to be recognised, and many interesting

---

[1] *Gaz. Med.* 1863, p. 665.

points of a complicated life-history have been worked out.

In the first issue of this Dictionary Lewis described the filaria sanguinis hominis nocturna as follows: 'Its average length is $\frac{1}{75}''$ ($= 0{\cdot}34$ mm.); its breadth $\frac{1}{3500}''$ ($= 0{\cdot}007$ mm.), or about equal to the diameter of a red blood-corpuscle. It is enclosed in a transparent tubular sac, within which it can be seen to alternately contract and elongate itself. This sac is extremely delicate and translucent, and may sometimes, when the worm has shortened itself more than usual, be seen collapsed and folded like a ribbon, and the next moment be instantaneously straightened again, by the extension of the filaria to its ordinary length. After death the worm may occupy either the entire length of the tubular sac, or be so contracted as to leave the tube empty at one or both ends, as may be observed in the woodcut (fig. 54).'

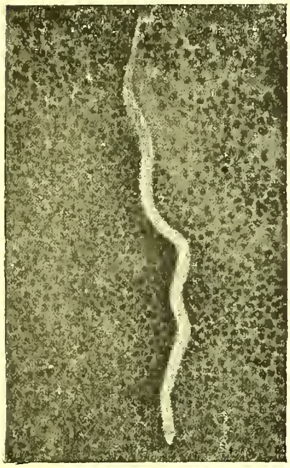

FIG. 52 — Filaria sanguinis hominis nocturna × 180.—1. Measures $\frac{1}{80}$ in. by $\frac{1}{3500}$ in., or thereabouts. 2. Is provided with a coarser sheath. 3. Caudal end tapers gradually for about one-fifth of the entire length of the animal, and terminates in a sharp, or nearly sharp, point. 4. Cephalic end is rounded off, and has obscure oral movements of a pouting character. 5. No tongue-like organ visible. 6. Appears in the blood at night, disappearing during the day. 7. Has a wriggling, but no locomotive, movement. 8. Many specimens have a well-marked granular-looking aggregation about the middle of the body.

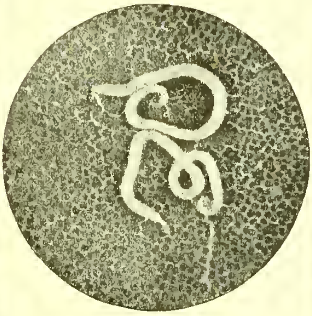

FIG. 51. — Filaria sanguinis hominis diurna × 180 (this fig. and figs. 52 and 53 from micro-photographs by C. Detmold).—1. Measures $\frac{1}{80}$ in. by $\frac{1}{3500}$ in., or thereabouts. 2. Is provided with a very delicate sheath. 3. Caudal end tapers gradually for about one-fifth of the entire length of the animal, and terminates in a sharp, or nearly sharp, point. 4. Cephalic end is rounded off, and has distinct oral movements of a pouting character. 5. No tongue-like organ visible. 6. Appears in the blood during the day, disappearing during the night. 7. Has a wriggling, but no locomotive, movement. 8. A few specimens have a faintly marked granular-looking aggregation about the middle of the body, but in none is it very well marked.

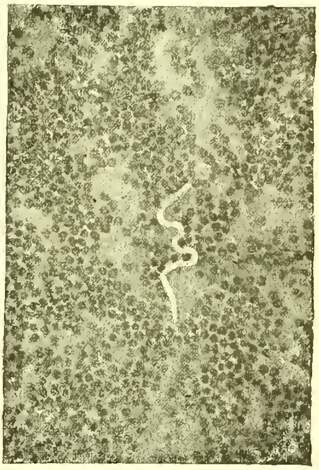

FIG. 53. — Filaria sanguinis hominis perstans × 180.—1. Measures $\frac{1}{125}$ in. by $\frac{1}{5500}$ in., or thereabouts. 2. Has no sheath. 3. Caudal end tapers more gradually for two-thirds of the entire length of the animal, and is abruptly truncated where it has tapered to about one-third of the diameter of the thickest part of the body. 4. Cephalic end is either conical or truncated, passing from one form to the other rapidly by a peculiar jerking, extruding and retracting, movement. 5. From time to time, a minute tongue-like organ is rapidly protruded and withdrawn at the extremity of the cephalic end. 6. Observes no periodicity. 7. Has a locomotive as well as a wriggling movement. 8. No granular appearance.

As no sign of growth or of reproductive organs is distinguishable in this the hæmatozoal stage of the parasite, it is evident—and this was early recognised—that these blood-worms are only the immature young of parasites which must exist in a sexually mature form elsewhere in the tissues of the human host, and in intimate relationship with the circulation. Lewis made diligent search for the parental form soon after his discovery of the embryo, but it was not until 1877 that he found two living specimens—a male and a female—in the diseased tissues of a nævoid elephantiasis of the scrotum. Late in the previous year Bancroft, in Brisbane, found several mature females in a 'lymphatic abscess' of the arm, and also in 'an encysted hydrocele of the cord.' The latter were carefully examined by Cobbold, and the parasite was named by him filaria Bancrofti. Since that time the mature filaria Bancrofti has been found in India, China, and Brazil. It is a long, thread-like worm, about the thickness of a horse-hair, of a white colour and firm consistence, and exhibits considerable activity, and a remarkable tendency to coil. Cobbold described the female as follows:

'Body capillary, smooth, uniform in thickness. Head with a simple circular mouth, destitute of papillæ (fig. 55). Neck narrow, about one-third of the width of the body. Tail of female simple, bluntly pointed; reproductive outlet close to the head; anus immediately above the tip of the tail. Length of largest females 3½ in., breadth $\frac{1}{90}''$.' In the female the uterine tubes are packed with ova in all stages of development (figs. 56 and 57). Lewis gives the measurement of these, in which the embryos are distinctly visible, as $\frac{1}{666}''$ by $\frac{1}{790}''$. In a fresh specimen of the filaria examined by the writer the largest ova gave slightly greater measurements, and he saw that towards the vaginal end of the uterine horns the embryos lay outstretched, and that in the vagina they had very much the appearance they have in the blood, proving that under normal circumstances the parasite is viviparous. Lewis gives the breadth of the fragment of a male he examined as $\frac{1}{180}''$.

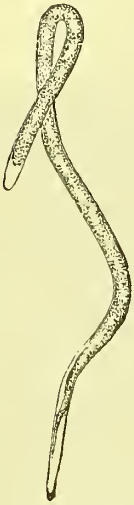
FIG. 54.—Filaria sanguinis hominis nocturna. × 300. (Traced from a micro-photograph.)

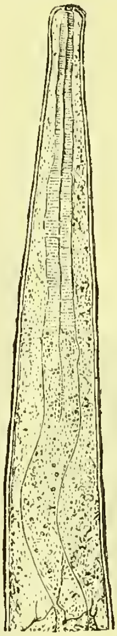
FIG. 55.—Anterior end of mature filaria sanguinis hominis nocturna.—Mature form. × 100 diameters.

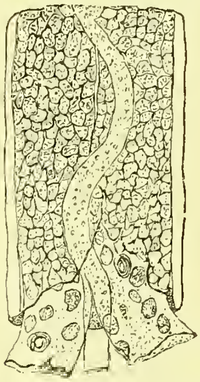
FIG. 56.—A portion of the mature filaria sanguinis hominis nocturna, showing uterine tubules filled with ova in various stages of development; also the intestinal tube. × 100 diameters.

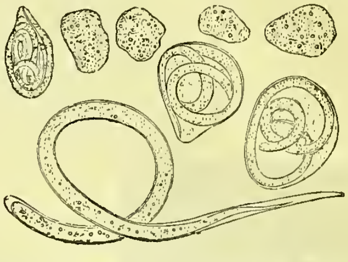
FIG. 57.—Ova and embryos of filaria sanguinis hominis nocturna. × 300 diameters.

It is now known that the parent worms live together in the lymphatics; that the embryo while *in utero*, by dint of vigorous movements, stretches its chorional envelope to form the long tubular sheath in which it lies extended, as we see it in the blood and lymph, and that, after this stretching of the chorion is complete, the embryo is born into the lymph-stream, which carries it through the glands, along the thoracic duct, and thus into the blood. Under ordinary circumstances of health and habit the hæmatozoon cannot be found in the blood during the day, but at evening it appears there. At first only a very few can be found; as night advances their numbers gradually increase; about midnight they attain their maximum—in some cases as many as 200 may be found in a single drop—after this they gradually diminish up to about 8 or 9 A.M., when they disappear for the day. An attack of fever may disturb this periodicity, and Dr. Stephen Mackenzie[1] has shown—and his observations have been abundantly confirmed—that by causing the subject of filaria infection to sleep during the day and keep awake during the night, the habit of the embryo parasite in his blood is correspondingly changed: it then appears, contrary to its normal habit, in the blood during the day, and disappears from it at night. *See* NEGRO LETHARGY.

This singular periodicity is, apparently, an adaptation to the nocturnal habits of the female of a particular species of mosquito, which imbibes with the blood the young filaria, and acts as its intermediary host.

---

[1] *Trans. Path. Soc.* 1882, vol. xxxiii.

Transferred to the stomach of the mosquito, the filaria first casts its chorional envelope, and then bores its way into the thorax and thoracic muscles of the insect. Here it undergoes a remarkable metamorphosis, eventuating in its becoming possessed of an alimentary canal, a circumcaudal circle of papillæ, and greatly increased size, power, and activity. This metamorphosis takes about six days to complete. At the end of this time the mosquito dies, after depositing her eggs on the surface of the water to which she resorts for this purpose. It is presumed that the filaria then escapes from the body of the insect to the water, into which the latter has probably fallen. Through this medium, it is believed, it gains access to the human body, being swallowed in drinking-water.[1]

Geographical Distribution.—The filaria sanguinis hominis nocturna has been found in most tropical and subtropical countries in which it has been properly looked for. Its exact geographical distribution as an endemic parasite is doubtless in keeping with the geographical distribution of the particular species of mosquito subserving its interests as intermediary host; but, as the filaria may live for many years in the tissues of its human host, it is frequently brought by travellers from tropical and other countries to colder latitudes; and there is at least one well-authenticated instance in which it was found in a patient who had never quitted England.

Pathological Relations.—Chyluria, nævoid elephantiasis or lymph-scrotum, chylous dropsy of the tunica vaginalis (variously termed chylocele, lymphocele, galactocele), varicose and indurated inguinal glands, chylous ascites, recurring orchitis, certain kinds of abscess occurring in the limbs—especially in the thighs and groins, lymphangitis, and lymphatic fever, are almost invariably accompanied or preceded by the presence of the filaria in the blood or in the lymph, or in both. The association is so constant and so intimate, that in 99 cases out of 100 these diseases may bo confidently attributed to the filaria, at all events when they are of tropical origin.

Tropical elephantiasis arabum is also attributed to the filaria, although the parasite is by no means always found in the fully developed cases. Theoretically, all elephantoid diseases are produced by some mechanical or other physical influence operating by obstructing or irritating the lymphatic vessels. In tropical elephantiasis it is maintained that this influence is the filaria nocturna; and on the following grounds. Cases are on record of lymph-scrotum—a disease certainly attributable to the filaria—passing into true elephantiasis arabum; many cases of true elephantiasis arabum scroti have a history of antecedent lymph-scrotum; lymph-scrotum has supervened in flaps left after removal of an elephantiasis scroti by operation; elephantiasis of the leg has followed on the removal of a lymph-scrotum; lymph-scrotum and elephantiasis of the leg sometimes co-exist in the same individual; a case is on record of lymphorrhagia in an elephantoid leg co-existing with varicose inguinal glands and filariæ, and in which chyluria subsequently developed; an instance is recorded in which a son developed a lymph-scrotum, and the mother—living in the same house—an elephantiasis of the leg; where elephantiasis is endemic, there too chyluria and lymph-scrotum are found. It is unreasonable to suppose that the combinations and concurrences mentioned were, in every instance, simply coincidences; much more likely the same cause produced them all. This being proved to be the filaria in chyluria, lymph-scrotum, and varicose inguinal glands, it follows that it must be the filaria also that produces true tropical elephantiasis arabum. Furthermore, as far as known, the geographical distribution of elephantiasis is co-extensive with that of the filaria.

Because the filaria is not always found in elephantiasis, it has been maintained by some that this parasite cannot be the cause of this disease. The fact is, the filaria is mortal and may die before its host; nevertheless, the ill it has wrought may not disappear at its death. It sometimes happens that in chyluria and in lymph-scrotum no filariæ can be found in the blood, urine, or lymph, although at one period they must have been present; sometimes it can be found in the lymph only, and not in the blood; and instances are on record in which the parasite disappeared from the blood and lymphous discharges whilst the cases were under observation, yet the characteristic morbid discharges persisted. In pathology, as in other things, a transient influence may produce a permanent lesion. It must be admitted, however, that the reason of the very frequent absence of the embryos of the filaria from the blood in developed elephantiasis is not known, and further observations bearing on this point are much wanted.

From the fact that in many countries where the filaria is endemic quite 10 per cent. of the adult population harbour it, yet only a small proportion have any of the diseases enumerated, it is evident that the parasite does not necessarily give rise to disease. It would appear that so long as the parasite is healthy and normally situated it is innocuous. Should it die, it may act as a foreign body and cause abscess; the dead filaria has actually been found in lymphatic abscesses. But the precise way in which the parasite usually brings about pathological obstruction of the lymphatics is, as yet, to some extent a matter of conjecture. Of two ways in which it so acts there is good evidence. (1) The parent worm may cause lymphatic stasis by operating at a point high up the thoracic duct, either itself plugging that vessel, or giving rise to inflammatory thickening in or around its walls, ending in stricture. (2) As mentioned, there are instances on record in which, though the filaria was present in the chylous urine, or in the lymph drawn from a lymph-scrotum, or from varicose inguinal glands—yet, after the most careful and prolonged search, it could not be discovered in the blood. It is evident that in these cases there must have been complete obstruction of a lymphatic area, otherwise the filaria embryos must have appeared in the blood, as in ordinary examples of filarial infection. The obstruction could not possibly have been in the thoracic duct, for, if complete in this situation, it must have speedily brought about the death of the patient. It is safe, therefore, to infer that it must have been somewhere on the distal side of the receptaculum chyli. In two such cases the ova of the parasite have been found in the lymph; and it is believed that in this circumstance we have the explanation of the site and character of the lymphatic obstruction in a large proportion of cases. Normally, the parasite is viviparous, and the long, slender, active embryo has no difficulty in finding its way along the lymphatics and through the glands into the circulation. But should the embryo be born prematurely, as in the two cases referred to, before the chorional envelope has undergone the stretching process already described—that is, should ova (seven or eight times the diameter of the outstretched young) be prematurely launched into the lymph-stream, they act as emboli, and, being very numerous, effectually plug the glands connected, directly or by anastomosis, with the lymphatic vessel in which the aborting parent lies. The location of the worm; the degree of obstruction, whether caused by embolism, pressure, or stricture; pressure by enlarged glands interfering with the compensating drainage of the affected areas by the veins; traumatic irritation of the congested lymphatic area; the position of the part involved as regards dependence or elevation, a most important factor in elephantiasis; the health of the patient; and other circumstances, easily understood, will determine the site and exact character of the resulting disease.

---

[1] For a detailed description of the metamorphosis of the filaria in the mosquito, see *Trans. Linnean Soc. of London*, vol. ii. part 10; 2nd ser. 'Zoology,' April 1884.

Treatment.—(*a*) *Curative.*—No means of killing the filaria have been discovered. The indications for treatment, when disease has developed, are supplied by the pathology. Rest, elevation of the affected parts, elastic bandaging, and other means to facilitate the flow of lymph through the damaged lymphatics, are of great benefit. *See* Chyluria; and Elephantiasis Arabum.

(*b*) *Preventive.*—The fact that the mosquito acts as intermediary host indicates the direction that preventive measures should take. Drinking-water, in districts where the filaria is endemic, ought to be boiled and filtered; wells, cisterns, and receptacles for drinking-water ought to be covered with fine wire-gauze, to prevent the access of the mosquito; and persons known to harbour the parasite ought to sleep under properly constructed mosquito-curtains. By any or all of these means this parasite, in the course of a single generation, could be exterminated, and the diseases it produces made things of the past.

3. *Filaria sanguinis hominis perstans* (fig. 53).—The free hæmatozoal embryo of a species of nematode, the mature form of which is unknown. Hitherto this hæmatozoon has been found only in the blood of negroes from the West Coast of Africa, and it is probable that as an endemic cause it is restricted to this part of the world. Twice it has been found in company with the filaria sanguinis hominis diurna; in several other cases it was not so associated. We may therefore infer that the association of filaria perstans and filaria diurna in the two instances referred to was merely accidental.

Attention to the points of contrast between filaria perstans and the other blood-worms, as set forth in the table in page 697, will lead to its recognition. In addition to what has been stated in this table, it may be mentioned that the body of this parasite is possessed in a high degree of powers of elongation and contraction, and that the measurements given in the table referred to are those of the animal when it is dead or moribund. When travelling actively among the blood-corpuscles it sometimes so extends itself as to appear a mere thread, the elongation concurring with a corresponding attenuation; at other times, and when not actively travelling, it assumes the proportions given. A very striking habit which it has is that of coiling itself up like a rope, and remaining motionless in this attitude for a few seconds before resuming its usual movements. Another peculiarity worth mentioning is the result, apparently, of the locomotive habits of this parasite: not infrequently it is seen fixed to one spot on the slide, vainly endeavouring to break away, and constricted by a delicate rope of fibrin. It would seem that in moving about the slide it pushes the strings of fibrin in front of it, and at times becomes entangled in a rope of them.

The filaria sanguinis hominis perstans is probably very common in the endemic region; for, of ten negroes from the West Coast of Africa whose blood was searched, it was found in five.

That in certain cases it gives rise to pathological conditions is probable; but of what these are we are as yet ignorant. In one case the parasite was associated with the peculiar disease called Negro Lethargy or the Sleeping Sickness of the Congo; in another with insanity; but in the other three instances in which it was found there was no concomitant disease. There may be some grounds for associating it with a peculiar African disease called Craw-craw, a kind of itch, apparently induced by a filaria-like parasite, and not the acarus scabiei; as yet this supposition is little more than hypothetical.

The presence of a beak, the absence of a sheath, the marked locomotor habits, the extensibility and pliancy of its body, and also the non-observance of any periodicity in its entrances and exits from the circulation, suggest that the embryo filaria sanguinis hominis perstans gains its freedom and enters its particular intermediary host by dint of its own efforts, and that it is not, as is the case with filaria sanguinis hominis nocturna, and probably diurna, dependent on the good offices of some species of mosquito or other bloodsucker. PATRICK MANSON.

FISSURE (*findo*, I cleave).—A narrow and superficial crack or solution of continuity, observed on the skin and mucous membranes, and especially near the line of junction of these structures, as on the lips and within the anus. *See* ANUS, Diseases of; and CHAPS.

FISTULA (*fistula*, a pipe).—A narrow track or canal leading from a free surface, and extending more or less deeply to some seat of local irritation; or it may be constituting an abnormal communication between two or more cavities, as in the case of vesico-vaginal or recto-vaginal fistula. *See* ABSCESS.

FISTULA IN ANO.—*See* RECTUM, Diseases of.

FIT.—A popular synonym for a sudden seizure characterised by loss or disturbance of consciousness from any cause, with or without convulsions (*see* CONVULSIONS; EPILEPSY; HYSTERIA; and SYNCOPE). The term is also applied to a sudden or acute seizure of certain diseases, such as gout, asthma, and ague.

FLATULENCE (*flatus*, a puff of wind). SYNON.: Fr. *Flatulence*; Ger. *Flatulenz.*

DEFINITION.—The undue generation of gases in the stomach and intestines.

ÆTIOLOGY.—The principal cause of flatulence is fermentation or decomposition of the contents of the stomach and bowels—a condition usually induced by embarrassment of function. Hence it is a common symptom in dyspepsia—especially the atonic forms as met with in the debilitated and the aged, constipation, gastritis, enteritis, hepatic disorders, and intestinal obstruction. When flatus is generated too rapidly to be accounted for by fermentation, as in hysteria, hypochondriasis, and other forms of nervous debility, it has been ascribed to secretion of gases from the mucous membrane.

SYMPTOMS.—The clinical phenomena vary as flatus is retained or discharged; and with the seat of its formation, whether chiefly in the stomach or intestines. In the former the concomitant symptoms are those of dyspepsia; in the latter there is usually constipation. As a rule, however, flatulence pervades at the same time more or less all the hollow viscera, and indicates torpor of the digestive organs. It is apt to lead to these further evils:—(*a*) *Pain* from distension or from irregular and forcible contractions of the walls—hence gastrodynia and colic are apt to arise; (*b*) *arrest of the normal movements* of the stomach and intestines, and consequent accumulation within them of fermentable matters, with further generation of gases, leading to paralytic distension: hence dilatation of the stomach and colon, tympanites or meteorism, and aggravation of pre-existing dyspepsia or constipation may ensue; and (*c*) *pressure on adjacent organs*, such as the heart and lungs, inducing palpitation and irregular action of the heart, precordial anxiety, faintness, vertigo, dyspnœa, or even asphyxia.

In tympanites there is a rapid generation of flatus, which overpowers the contractility of the hollow viscera; and the abdomen is round, tense, and tympanitic. *See* TYMPANITES.

TREATMENT.—(*a*) *Imprisoned flatus should be dislodged* by friction of the abdomen with stimulating liniments, and gentle kneading of the most distended parts; large draughts of hot water; spirit and hot water; ammonia, ether, or spirit of chloroform; aromatic stimulants—ginger, capsicum, cloves, mint, anise, cajuput, camphor, or cascarilla. When flatulence is chiefly intestinal, enemata containing laudanum with asafœtida, turpentine, or rue; and the compound asafœtida pill with extract of nux vomica, and an aperient, are the most useful measures.

(*b*) *The generation of flatus should be arrested.* Fermentation may be checked by sulphite or sulpho-carbolate of sodium, sulphurous acid, carbolic acid, creasote, terebene, salol, or charcoal—from the poplar or vegetable ivory, immediately after food; and by correcting and toning the digestive organs. Repeated fractional doses of calomel will also frequently arrest fermentative flatulence. Food likely to ferment or lodge, such as starch, sugar, fruits or green vegetables, and warm liquids—especially tea and soups—should be avoided; the meals should be well masticated and solid throughout, and liquids should only be taken sparingly at the close or an hour after. In some cases, however, flatulence is connected with an insufficient supply of fluids, and should be met by increasing it; then also a tumblerful of hot water night and morning and an hour before each meal, which should consist of solids, may prove useful. Alkalis—carbonate of magnesium and bicarbonate of sodium—and bitters, especially strychnine, are often useful in the flatulence of hysteria, hypochondriasis, of the very nervous and the aged; but perhaps the best results follow alkalis with nux vomica and bismuth an hour before, and hydrochloric acid alone or with some reliable preparation of pepsin after food. It is also essential to see that the action of the liver is healthy. George Oliver.

FLEXION (*flecto*, I bend).—A bending. This term is applied either to the act of more or less forcible flexion, as in some methods of treatment, for example in the cure of aneurysm or the reduction of dislocations; or to the condition in which parts are bent, as the result of disease or of disorder, as when the limbs or certain internal organs are bent upon themselves. *See* Womb, Diseases of.

FLINSBERG, in Silesia.—Chalybeate waters. *See* Mineral Waters.

FLOODING.—A popular term for excessive discharge of blood from the womb. *See* Menstruation, Disorders of; and Pregnancy, Disorders of.

FLUCTUATION (*fluctus*, a wave).—A physical sign consisting in a wave-like or undulating sensation. It is elicited by a peculiar mode of palpation with the one hand, while percussion is made with the fingers of the other; and is due to the presence of a fluid in a natural cavity, such as the peritoneum, or in an abnormal closed space such as a cyst (*see* Physical Examination). The term 'fluctuation' as used by the surgeon has a somewhat different signification, being applied to the sensation of the presence of a fluid which may be felt when alternate pressure with the fingers is made, as over the seat of an abscess. *See* Abscess.

FLUKE.—*See* Entozoa.

FLUOR / **FLUX**.—A flow or excessive discharge from a mucous surface, through any of the natural passages, of serum, blood, mucus, pus, or the various secretions. As illustrations of fluxes may be mentioned salivation, bronchorrhœa, biliary flux, diarrhœa, dysentery or bloody flux, cholera, and leucorrhœa or white flux (*fluor albus*).

FŒTUS, Diseases of the.—Two classes of abnormal conditions are seen in the fœtus, namely: Those which depend upon some interference with the process of development, such as malformations and monstrosities; and those which are the result of disease. This article treats of the latter only.

1. *Amputation.*—Amputation, partial or complete, of fœtal limbs may take place, from constriction of the limb by a band of the amnion. An attempt at reproduction of the lost limb is sometimes seen, in the shape of rudimentary fingers and toes, projecting from the stump. That such a stump is the result of amputation is proved by the fact that the part cut off has been found *in utero*.

2. *Spontaneous fractures and dislocations.* Fractures and dislocations occur *in utero*, the latter being the more rare. They are due to some condition of the bones and ligaments respectively, leading to undue fragility of those structures; for they are always multiple, and are not accompanied with bruising of the adjacent soft parts.

3. *Tumours.*—New-growths are met with in the fœtus—cysts of various kinds, fibroma, lipoma, &c. That most special to the fœtus is a tumour situated over the coccyx, which may be as large as a fœtal head. Such tumours are spheroidal or ovoidal in shape, elastic in consistence, and present rounded inequalities on the surface. On section they are found to consist of strong fibrous trabeculæ, in the meshes of which are numerous small cysts lined with epithelium. It is thought by many that they originate in Luschka's gland. Another special kind of tumour is that known as a *fœtal inclusion*—a swelling usually on the lower part of the trunk, and containing some part of another fœtus, more or less imperfectly developed.

4. *Inflammation of serous membranes.* This form of disease may occur in the fœtus, such as pleurisy and peritonitis. The morbid anatomy of these changes does not differ from that in the adult. Peritonitis is often found associated with syphilis; and it appears to be almost always fatal to the fœtus.

5. *Visceral inflammations.*—Inflammation of the lungs has been met with, in the form of grey or white lobular hepatisation. It is most frequent in syphilis. Enteritis has also been described. Certain malformations of the heart which are met with can be explained by supposing the occurrence of endocarditis during fœtal life; but there is no proof that the fœtus is subject to rheumatism.

6. *Specific fevers.*—The morbid changes of *enteric fever* have been found in the fœtus. In pregnant women suffering from *intermittent fever*, paroxysms of convulsive movements of the child have been felt to occur as regularly as the attacks of ague in the mother; and the child when born has been found to have a large spleen. Children have also been born with skin-eruptions thought to resemble those of *measles*, *scarlatina*, and *small-pox*. The facts as to the last-named disease are the most numerous and probable. The eruption of variola in the fœtus differs some-

what from that seen after birth, because, the skin of the fœtus being bathed with fluid, no crusts form, and the pustules run a course like those on mucous membranes.

7. *Diseases of the skin.*—The fœtus is subject to skin-diseases. Pustules of ecthyma; patches of erythematous redness; ulceration of the skin, and syphilitic eruptions, have been seen. Intra-uterine ichthyosis is met with. Children have been born jaundiced, but only by mothers themselves suffering from that condition. But women with jaundice do not always bear jaundiced children. Jaundice is not necessarily fatal to the fœtus.

8. *Syphilis.*— Syphilis leads to various lesions in the fœtus; and while it usually proves fatal, the subjects of it that may survive till birth are feeble and badly nourished. Flat tubercles occur on different parts of the skin, especially round the mucous orifices; and pemphigus may be seen, affecting chiefly the palms of the hands and the soles of the feet. The occurrence of peritonitis has already been mentioned. Yellow indurated nodules, of varying size and number, may be found in the liver, as well as in the lungs. A peculiar change has been described in the thymus gland, in which this structure externally appears healthy, but when cut into and compressed exudes a whitish puriform fluid. Other changes have been recorded, affecting the spleen, pancreas, and suprarenal capsules, but they are not distinctive. Changes in the bones have also been described, consisting of an osteochrondritis, affecting the ends of the long bones, most frequently the lower end of the femur.

9. *Rachitis.*—Fœtal rickets is a disease somewhat different from that seen after birth. The limbs are short, very fat, the fat being thrown into rolls separated by transverse constrictions; the trunk, especially the abdomen, is large; the head often hydrocephalic. The bones are short, often fractured and bent; there is swelling, softening, and delayed ossification of the epiphyses. It may begin early, and cease before delivery; or the child may be born with the disease in progress. Nothing is known of its causes.

10. *Tuberculosis.*—Tuberculosis sometimes commences in the fœtus, tubercles having been found in the mesentery and in the lungs.

11. *Dropsies.*—Dropsy is met with in the fœtus, sometimes of the serous cavities, of which hydrocephalus is the most common. It is often associated with rickets. Next in frequency comes ascites; and lastly hydrothorax, which is very rare. These affections may destroy fœtal life *in utero*; but they more often lead to death because they render destructive operations necessary before delivery can be accomplished. General anasarca is also met with, and there is reason to believe that it depends upon disease of the placenta, impairing the excretory function of that organ. It is always fatal, if not before birth, within a few hours after it.

12. *Visceral diseases.*—Hypertrophy of the liver, spleen, or kidneys may occur in the fœtus. Cystic disease of the kidneys may be met with, the organs being converted into a mass of cysts containing no trace of secreting structure. Both kidneys are usually affected, and the disease is generally associated with some malformation elsewhere. Hydronephrosis, single or double, along with dilatation of the ureter, or ureters and bladder, has been seen, dependent upon impermeability of some part of the urinary passages. Any of these visceral diseases may form a tumour so large as to impede delivery. None of them can be diagnosed before birth. Concretions of uric acid and urates are not uncommon.

The Causes of Death of the Fœtus. The various causes of death of the fœtus *in utero* may now be briefly considered. The first of these is *injury*, as when the mother receives a blow upon the abdomen, or has a fall. Such occurrences rarely injure the fœtus directly, although this has been known to happen. When they prove fatal to the fœtus, they do so by leading to hæmorrhage into, or separation of, a portion of placenta, and consequent disturbance of the fœtal circulation. *Poisons* in the mother's blood, such as lead, urea, bile, or carbonic acid (as in the case of heart-disease with cyanosis), may lead to death of the fœtus. *Syphilis* has already been referred to. Epileptiform *convulsions* may destroy fœtal life, either by asphyxia, or by leading to hæmorrhage into the placenta. Extreme *anæmia* and the *cancerous cachexia* are among the causes of fœtal death. Any kind of disease attended with *pyrexia* will also destroy fœtal life if the temperature rise high enough. A temperature exceeding 105° F. appears to be invariably fatal to the fœtus. Certain *diseases of its appendages* may lead to death of the fœtus, such as hæmorrhages into the placenta, old organised clots forming what are called placental 'infarcts'; obliteration of the umbilical vessels; or interruption of the circulation in the cord by knots in it, or pressure upon it. It is believed that there are some *diseases of the mother's uterus* which lead to death of the fœtus; but what they are is not known. It is said that some women acquire a habit of having dead children. This means that there are cases in which an apparently healthy woman will repeatedly have dead children, the cause of whose death a skilled observer cannot find out. In other words, there are causes of fœtal death as yet unknown.

The Consequences of Death of the Fœtus.—A dead fœtus while retained *in utero*, and thus protected from the air, does not putrefy, but undergoes a process of maceration. The whole body becomes soft and flaccid, its tissues being infiltrated with fluid; but it has no putrid odour. The skin presents bullæ filled with reddish serum, and the epidermis is readily detached with slight friction. The surface is of a cyanotic colour, which after exposure to the air becomes of a more or less bright red; it is not greenish as is seen in putrefaction. The cellular tissue is infiltrated with bloody serum. The viscera have lost their distinctive tints, and become of a reddish-brown colour. The cranial bones are abnormally mobile, overlapping one another to a greater extent than normal; and the periosteum may be stripped off them. These appearances are much the same, whatever be the cause of death, but they vary in degree according to the length of time which has elapsed since death.

Besides the diseases of the fœtus described above, there are others which are not fatal, and the chief interest of which lies in their course and treatment after birth. These are discussed in other articles, and need not be mentioned here. G. E. Herman.

FOLIE CIRCULAIRE (Fr.)—This term is applied by the French psychological physicians to a variety of insanity characterised by alternations of excitement and depression. The patient passes through an attack of mania of perhaps an ordinary character, but when he appears to have recovered he sinks into melancholia, and thence emerges again to become maniacal and excited. The duration of each stage may vary from weeks to months. Sometimes one state will follow the other immediately; in other cases a period of convalescence will intervene, during which the patient appears well, and can hardly be considered insane. Yet the prognosis is extremely unfavourable in all such cases; and it is of great importance in estimating the extent of recovery of a patient, that it should be clearly ascertained that the attack is not one of a series following one another in the manner mentioned.

G. F. Blandford.

FOLLICLES, Diseases of (*folliculus*, dim. of *follis*, a bag).—The name 'follicle' has been applied to a great variety of different structures, which have in common the shape of a bag or sac, whether circular or elongated in outline; for example, the Graafian follicles, the lymphatic (Peyerian) follicles of the intestine, and the follicles of the mucous membrane of the stomach, intestine, and uterus. The name has been further extended to include glands somewhat more complex in structure, such as the sudoriparous glands or sweat-follicles, the sebaceous follicles, and the tonsils; as well as the saccular depressions in which the hair and the teeth take their origin. The name *synovial follicles* is sometimes given to processes of synovial membrane invaginated in the capsule of a joint.

For an account of the diseases of these various structures, the reader is referred to the several articles under which they are discussed; but so far as the true follicles are concerned, the following may be said to be the principal morbid changes to which they are liable: atrophy; hypertrophy; obstruction, and distension; inflammation; ulceration; cystic disease; new-growths; tubercle; acute specific processes, such as the typhoid; and parasitic disease.

FOMENTATION (*foveo*, I keep warm). Synon.: Fr. *Fomentation*; Ger. *Bähung*.

Definition.—Fomentation is the application to the surface of the body of flannels, cloths, or sponges moistened with hot water, either pure or containing some medicinal substance in solution.

Action.—The action of a simple fomentation is the same as that of a poultice. By its warmth and moisture it tends to relax the muscular fibres of the skin and soften the cuticle, thus relieving tension, and diminishing pain and irritation. In the early stages of inflammation it favours resolution, by maintaining the temperature, and promoting active circulation through the area which has suffered from the injurious influence which has started the process. In the later stages it promotes and hastens suppuration, by causing dilatation of the vessels, and encouraging exudation. A fomentation is superior to a poultice in lightness and cleanliness, but unless care be taken it loses its heat more quickly. This disadvantage may be overcome by covering the fomentation with a thick layer of cotton-wool.

Application and Uses.—A fomentation is thus applied: A piece of coarse flannel, sufficiently large to cover the affected part when folded into two layers, is put into a basin, and boiling water is poured upon it. It is then lifted from the basin with a pair of tongs or some convenient instrument, and dropped on the wringer. This is a stout piece of towelling with a stick attached to each end. The sticks then being twisted in opposite directions, as much water as possible is squeezed out of the flannel. It is then immediately placed on the affected part, and covered with a large piece of oiled silk or indiarubber sheet extending at least one inch on each side of it. Over this may be placed a thick layer of cotton-wool, and a bandage. If the flannel be not squeezed sufficiently dry, it will wet the bed or clothing. If not sufficiently covered with oiled silk and wool, it soon becomes cold. Whatever means may be taken to retain the heat of a fomentation, it can be kept above the temperature of the body only for a few minutes. If, therefore, the full effect of fomentation is desired to be obtained, the flannels must be changed every twenty minutes. In many parts a sponge, or a piece of spongio-piline, wrung out of boiling water, forms a most convenient form of fomentation. When the fore-arm or hand is affected, a bath of hot water may be substituted for fomentations. The temperature of the water must be maintained by the repeated addition of small quantities of boiling water.

Fomentations are especially useful in all cases of erysipelas and diffuse cellulitis, and in boils. In peritonitis they are borne more easily than poultices, on account of their greater lightness. Whenever they can be employed they are superior to poultices, on account of their cleanliness. They are not applicable to cases in which there is a discharging wound or abscess, as under such conditions the cloths become foul.

VARIETIES.—If it is desired to add some slight counter-irritation to the warmth and moisture, the fomentation may be sprinkled with turpentine before it is applied. This forms the ordinary *turpentine-stupe.* The sedative action of the fomentation may be increased by sprinkling it with laudanum. The ordinary poppy-fomentation is often used with the same intention. It is thus prepared: Half a pound of poppy-heads with the seeds taken out is boiled for ten minutes in four pints of water, and the liquid then strained off. The decoction is kept warm over a fire, and the flannels dipped in it and applied as before described about every half-hour. The term 'dry fomentation' is sometimes applied to bags of hot salt, bran, or chamomile-flowers; or pieces of flannel toasted before a fire and laid on hot. These often give relief in cases of intestinal, renal, or biliary colic. MARCUS BECK.

FOMITES (*fomes*, touch-wood, tinder).—Substances capable of retaining contagium-particles, and thus of being the means of propagating any infectious disease. The most important fomites are bed-clothes, bedding, woollen garments, carpets, curtains, and letters. *See* CONTAGION.

FOOD.—*See* ALIMENT; and DIET.

FOOD, Ætiology of.—*See* DISEASE, Causes of; and DIGESTION, Disorders of.

FORAMEN OVALE, Patency of.—*See* HEART, Malformations of.

FORCIBLE FEEDING.—In the treatment of insanity, and sometimes under other circumstances, it happens that we are compelled to administer food by force to patients who, for one reason or another, refuse to take it. The majority of these persons are melancholics who think they ought not to eat, or try to commit suicide by starvation, and many are in a feeble bodily condition when they commence this refusal. Such persons must be fed by force. Strong patients may be allowed a longer time, for many refuse from whim or obstinacy, and hunger will overcome their disinclination. Some patients in a state of acute delirium will take no food; they must be fed at once, and it is important that they should be fed without a protracted and exhausting struggle, for they will resist desperately unless completely overmastered. In almost every case feeding should be done early: the sooner it is done, the shorter will be the period during which it will be required. The various plans to be adopted range from merely feeding with a spoon, as one feeds a child, to sending food down the œsophagus with a tube passed through the mouth or nose, the patient being restrained in a chair or on a bed by attendants or by mechanical means. The mode of feeding varies according to the resistance, and no one method is applicable to every case. There is no need to pass an œsophageal tube down the throat of a man whose resistance is passive and easily overcome; on the other hand, we occasionally find patients of great muscular strength and indomitable will, who can hardly be fed with safety in any way except by the stomach-tube. Of these we may speak first.

In what position are they to be fed, sitting or lying down? If they are to be held by attendants, no doubt the recumbent posture is the one in which the latter can exercise most power. But when a man is so strong that, as we are told, five attendants must hold him, a struggle will not be unattended with danger, for the five are not all acting together, and he gets loose now a leg and now an arm, to the great discomposure of the operator; moreover, this struggle repeated three times a day, soon renders him a mass of bruises. He should be placed in a strong wooden chair, and by sheets wound round his body, arms, and legs, he can be fastened to the chair so completely that he is quite incapable of movement; yet he gets no bruise, and the operator acts upon him free from all inconvenience. Some writers advocate feeding by the nose, and prefer this method to passing a tube through the mouth. It is well fitted for quiet patients, who do not make a desperate resistance and only close their teeth, but it has many disadvantages. A long tube may enter the larynx, or may curl forwards and be caught by the teeth. And if the food is passed into the nose by a short tube or funnel, it is often ejected, and a long time is spent in the operation. The time consumed in feeding by the nose is one of the great objections, and much exhaustion is often thus produced. The only advantage of feeding in this way is that we are not compelled to force open the mouth. This is a work of difficulty, if the patient is strong and his teeth perfect, unless we are provided with the screw-key invented for this purpose: with this there is little difficulty, and only bungling will injure the teeth or gums, if the patient is properly secured and the head held by an attendant, not between his knees, but in his hands. If the œsophageal tube be of good size it cannot enter the larynx. The wooden termination of the tube must be short, so as to allow of its curving. The operator, standing in front, passes the tube through the hole of the gag, inclining it to the patient's left, so as to avoid the vertebræ. It may be held by the tongue, but at the first inspiration the hold is relaxed, and it glides down the œsophagus. The food may be poured down it by a funnel or pumped down by the pump.

The next class of patients, making less resistance, may be fed by Paley's feeder, a glass vessel with a flattened spout which goes over the tongue; the food is emitted, a little at a time, by means of a spring, and finds its way down the gullet. A certain number of patients may be fed by getting a funnel behind the teeth and pouring food into it; and others by holding the mouth open by means of two spoons, and then pouring food in. The objection to the latter method, and to its many modifications, is the time taken up in the operation, whereby great fatigue and exhaustion are produced.

The food must be in a more or less fluid form, and should consist of soups, milk, eggs, and the like. *See* DIET.

G. F. BLANDFORD.

FORMICATION (*formica*, an ant).—An abnormal subjective sensation referred to the skin, which is described as of a 'creeping' character, and as resembling the crawling of ants upon the surface. *See* SENSATION, Disorders of.

FOURTH NERVE, Diseases of.—Morbid states of the fourth nerve are shown by *spasm* or *paralysis* of the superior oblique muscle, which it supplies.

Spasm.—Little is known of over-action of this muscle, except that clonic spasm in it is the cause of rotatory nystagmus when the quick movement of the upper end of the vertical axis is inwards.

Paralysis.—Paralysis is not uncommon. Its usual causes are inflammation of the nerve-sheath from cold; hæmorrhage into the nerve; syphilitic affections of the nerve or of its membranes; cerebral tumours, &c., pressing on or injuring the nerve at its origin from the valve of Vieussens, or in its course around the crus; aneurysm; exostoses or growths in the orbit; and degeneration of the nucleus, in common with the nuclei of the other nerves of the ocular muscles, from which it is occasionally paralysed in tabes, in 'progressive external ophthalmoplegia,' in the rare acute inflammation of the nuclei, and in sudden lesions in this part of the mid-brain. It has also been known to be involved in the rare affection of the muscles of the eyeball in diphtheritic paralysis.

SYMPTOMS.—Even in complete paralysis of the superior oblique muscle there is little obvious deviation of the affected eye. Movement downwards is, however, defective, and therefore diplopia exists when the eye is moved below a line which runs obliquely downwards from the healthy to the paralysed side, through the point of mid-fixation. The uncertainty which results from 'defective projection' of the image formed by the affected eye occurs chiefly in looking down, and in the corresponding downward position of the head. It is common for the first discovery of the defect to be that the patient becomes giddy when he goes downstairs, and sees two flights of stairs before him instead of one. The chief visible defect in movement of the affected eye (examined alone) is downwards and inwards, because it is when the eyeball is moved in this direction that the superior oblique has most influence on the vertical position of the eyeball. In the direct downward movement there is slight convergent strabismus, because the inferior rectus lacks the counteraction to its inward traction, so that its tendency to rotate the globe (lower end of vertical axis inwards) is also unopposed and perceptible. The diplopia which exists when both eyes look down is homonymous—that is, the image formed by the affected eye is on the same side as that eye. The left eye (if affected) being higher than the right, its image (the left) appears lower than the right image. The action of the superior oblique being to move the upper end of the vertical axis of the eye inwards, there is, in its paralysis, an abnormal divergence of the upper ends of the vertical axes, and the double images (being always inverted) will converge; their upper ends being nearer together than the lower. This is due to the obliquity of the false image (*e.g.* the left), and this obliquity is greatest when the eyeball is moved to the left and downwards, because in this position the rotatory power of the superior oblique is greater, and the obliquity is least in looking inwards and downwards. Thus the convergence of the images is greatest when the difference in height is least, and *vice versâ*. When the paralysis of the superior oblique has existed for some time, a secondary contraction of the inferior oblique may cause crossed diplopia on looking upwards.

TREATMENT.—The treatment of paralysis of the fourth nerve is in the main that of its cause. When due, as it very commonly is, to syphilis, iodide of potassium in full doses, with or without mercury, is necessary. Smaller doses of iodide with quinine or iodide of iron are also useful for rheumatic paralysis. Blisters to the temple are beneficial in the early stages. A little good, but not much, may be effected by applying the constant current from the eyelid to the forehead (Benedikt), a few cells only being used.

W. R. GOWERS.

FRAGILITAS CRINIUM (*fragilitas*, brittleness; *crinis*, the hair).—*See* HAIR, Diseases of.

FRAGILITAS OSSIUM.—A diseased condition of the bones, in which they are extremely fragile, so that they are liable to fracture from very slight causes. *See* BONE, Diseases of.

FRAMBŒSIA (*framboise*, a raspberry). SYNON.: Yaws; Fr. and Ger. *Pian*.

DEFINITION.—An exanthem consisting of an eruption of reddish-yellow tubercles, which gradually develop into moist fungous masses, without constitutional symptoms, or with only such debility as results from ulceration and prolonged discharge.

ÆTIOLOGY AND PATHOLOGY. — Yaws is epidemic among the African race, both in their native country and in the West Indies, especially during childhood—then also premonitory symptoms and pyrexia are more distinct. The disease is contagious and inoculable, and presumably due to a microbe; it has no relationship to syphilis, as was once supposed from a likeness to condyloma. It is not hereditary, and does not recur. 'Parangi' in Ceylon, and 'Button Scurvy' which occurred in Ireland prior to 1851, were diseases closely similar if not identical; and filthy water and excess of vegetable food appeared to promote them.

SYMPTOMS.—There is a period of incubation of from three to ten weeks in frambœsia, and pains in the limbs and *malaise* always precede the outbreak. The tubercles begin with little or no hyperæmia or tenderness, and range in size from that of a pin's head to a prominent mass two inches in diameter. Some subside without breaking the cuticle or destroying the derma; others become fungous, somewhat spheroidal masses, pinkish in colour, and with a dirty-yellow, sticky, fœtid secretion. Later on the fungus shrinks and is converted into a brownish scab, or ulceration extends deeply and widely into the tissues. The subsidence of the fungus is succeeded by a pigmented stain, and the healing of the ulcer by a dark depressed cicatrix.

Frambœsia selects by preference the face and neck, the joints, the feet, and the genital regions; and often forms a fringe of tubercles or a prominent ridge around the mouth, the nostrils, or the anus. The mucous membrane near these outlets may be affected in like manner. The lymphatic glands in the vicinity become large and tender.

DURATION AND RESULTS.—The duration of frambœsia averages three months, but may be prolonged to one or more years. Spontaneous cure is usual; but in cachectic subjects and when its development is irregular the constitution suffers, the excretions become offensive, and there is extreme prostration. Then the joints swell; ulcers with excessive discharge form around them; and the patient may be crippled for life, or may perish from septicæmia or asthenia.

TREATMENT. — The curative measures of yaws advised by the best authorities are cleanliness, generous diet, saline eliminants, and the local use of carbolic-acid lotions, diluted mercurial ointments, or iodoform. In the later stages constitutional remedies, such as mercury in minute doses, iodide of potassium, and tonics, are indicated. As regards prevention, every hygienic improvement is potent. In some parts of Africa and in Fiji a habit of inoculating the young prevails, so as to procure immunity in adult age, when frambœsia is much more severe.

ERASMUS WILSON. E. D. MAPOTHER.

FRANCE, South of.—The eastern part (Mediterranean coast) is dry and bracing, with a very clear atmosphere. The chief resorts in it are CANNES, MENTONE, HYÈRES, and NICE. The western part is moist and mild but variable, the principal places in it being ARCACHON, BIARRITZ, and PAU. *See* CLIMATE, Treatment of Disease by.

FRANZENSBAD, in Austria.—Alkaline sulphated waters. *See* MINERAL WATERS.

FRECKLES.—SYNON.: *Lentigines*; *lenticulæ*; Fr. *Ephélides*; Ger. *Sommersprossen*, *Sommerflecken*.—A freckle is a pigmentary discoloration of the skin, which has received its Latin or technical name from a resemblance in colour, figure, and size to a lentil. It varies in tint from yellow to olive, from brown to black; and is met with on the exposed parts of the skin, particularly the face, neck, and hands, and occasionally on the covered parts of the body ('cold freckles'). It is usually found in children and women in whom the skin is sensitive and delicate, and has obtained its German synonyms from its greater frequency in the summer season. *See* PIGMENTARY DISEASES OF THE SKIN.

ERASMUS WILSON.

FRÉMISSEMENT CATAIRE (*frémissement*, purring; *cataire*, connected with a cat).—A physical sign felt on applying the hand over the region of the heart or great vessels in certain morbid conditions, and compared to the sensation conveyed to the hand by the purring of a cat. This sign is more commonly known as 'thrill' or 'purring tremor.' *See* PHYSICAL EXAMINATION.

FREMITUS (*fremitus*, a low noise).—A group of physical signs, elicited by placing the hand over the respiratory organs, while the patient speaks (*vocal fremitus*), or coughs (*tussive fremitus*); or in certain morbid conditions when the patient simply breathes (*rhonchal* and *friction fremitus*). A fremitus may sometimes also be felt over the cardiac region in connexion with the movements of the heart, when the surfaces of the pericardium are much roughened. Another form of fremitus is a peculiar sensation called *hydatid fremitus*, which may be elicited by a special mode of percussion over hydatid tumours in some cases. *See* PHYSICAL EXAMINATION.

FRICTION. — SYNON.: Rubbing; Fr. *Friction*; Ger. *Reibung*.

DEFINITION.—By friction we mean surface-rubbing, as distinguished from *shampooing*, or, as it is sometimes called, *medical rubbing*, a process of manipulation by which deep pressure is made upon the muscles.

APPLICATIONS AND USES.—Friction is usefully employed over the surface of a limb, or over the trunk, for a variety of purposes. It is especially useful when the circulation is enfeebled, either by the external application of cold, amounting, when in a severe degree, to frostbite, or in cases of paralysis. The effect is still further increased by the use of various stimulating liniments, more especially when it is desirable to excite a certain amount of counter-irritation over a large cutaneous surface, for the relief of congestion or inflammation of internal organs.

Another object with which friction is largely employed in medicine, is to facilitate the absorption and introduction into the system of various remedial agents applied externally. By this means gastric irritation and disturbance are avoided, and the effects of the remedies upon the system can be more closely watched and regulated. In this way mercury is frequently introduced into the system by the process commonly spoken of as *rubbing in*, and salivation can be more easily avoided or checked at its commencement than when mercury is administered by the mouth. The part of the body selected for this purpose is that along the inner side of the thigh up to the groin; and mercury, in the form of ointment, rubbed in every night and morning, will generally affect the system in a few days.

Another instance of friction is to be found in the fattening of children by the process of rubbing in oil—fresh neat's-foot oil is the best—every night and morning, over the chest, abdomen, arms, and thighs. Emaciated children, thus treated, gain in weight by the absorption of the oil; and not only do they fatten, but their general nutrition and health are improved, often with the diminution of glandular swellings and the disappearance of coughs.

WILLIAM ADAMS.

FRICTION-FREMITUS.—The form of fremitus produced by the rubbing together of surfaces roughened by various morbid conditions, as of the pleura in breathing, or of the pericardium from the movements of the heart. *See* FREMITUS; and PHYSICAL EXAMINATION.

FRICTION-SOUND. — A physical sign, heard on auscultation, and due to the rubbing against each other of serous surfaces that have lost their natural smoothness and moistness from any cause. *See* PHYSICAL EXAMINATION.

FRIEDRICHSHALL, in Germany. Sulphated waters. *See* MINERAL WATERS.

FROSTBITES. — DEFINITION. — The local effects of severe or extreme cold upon any exposed parts or tissues of the body, more serious than those described as 'chilblains.'

The parts of the body most frequently affected by frostbites are the toes and neighbouring parts of the lower extremities, the fingers and hands, the nose, and the ears, all because of their especial liability to exposure, and the first named because also of their remoteness from the heart, and other disadvantages in their blood-supply.

By far the largest proportion of cases occur among men in or about the prime of life: first, because from the nature of their occupations they are most liable to exposure; and secondly, because from constitutional vigour they better withstand any immediately fatal general effects of exposure, and so survive with local damage.

SIGNS AND SYMPTOMS.—The signs and symptoms of frostbite vary in manifestation, in rapidity of occurrence and in succession, with the degree of cold, the medium and mode of application, and the duration of exposure, as also with the general condition of the sufferer. They may, however, be thus described: Transient redness of the part affected, accompanied by hyperæsthesia and tingling sensations, is more or less quickly followed by purplish lividity with diminished sensibility. Blanching, with numbness, supervenes. Next, congelation takes place, signalised by whiteness, hardness, and absolute insensibility. Lastly, the freezing process may extend more and more deeply, and be continued until all the tissues are literally 'frozen to death,' and their recovery is impossible. 'Dry gangrene' is then established, and the parts affected shrivel, dry up, and blacken. If the last stage indicated has not been reached, more or less complete recovery may be effected sooner or later. But 'moist gangrene' is liable to supervene, from inflammation after partial restoration of the circulation in the more severe cases; and other, though less serious trophic lesions, from similar cause, frequently occur in the milder cases. Parts that have not been actually frozen, but have been subject to repeated or long exposure, may become gangrenous, or may suffer from more or less permanent impairment of nutrition and function, such effects being due to organic damage to the nerves and blood-vessels. *See* GANGRENE.

TREATMENT.—The treatment of a frostbitten part essentially consists in such measures as are calculated to restore warmth, and re-establish the circulation. The greatest care, judgment, patience, and perseverance are requisite, or the attempts made may only render the mischief worse. The process must be gradual and slow to be safe.

The patient must not be brought at once into a warm room or near a fire, but should be kept in a moderately cold atmosphere, and in a recumbent position. The part affected should be somewhat raised, and gently rubbed with snow or bathed with ice-cold water for some time. Very gradually the temperature of the water may be raised, or oil may be substituted. Later, dry friction may be employed. The frictions should be carried considerably above the part obviously affected. From time to time the affected parts may be lightly enveloped in fur or wool, and the frictions repeated at intervals. After apparent restoration has been effected, treatment by friction, with or without some mildly stimulating liniment, should be persevered with day by day for some considerable period, and the part should be warmly clad. Consecutive inflammation of the skin, with vesication or superficial sloughing, occurs in some cases; in other cases the deeper structures also suffer, and moist gangrene results. Such conditions are especially liable to occur in cases in which the change from cold to warmth has been too rapid. They are to be treated *secundum artem.*

If, in spite of all efforts, restoration cannot be effected, and any part remains cold, dead, and gangrenous, or if from consecutive inflammation moist gangrene should supervene, it is better to wait for complete or almost complete separation of the dead structures before proceeding to amputation or other operative measures. The adjoining parts remain for very long in such depressed vital condition that, if cut through, they are little likely to heal favourably, and very often slough after fresh injury inflicted by operation wounds.

Parts that have been severely frostbitten, even if preserved, are liable to suffer permanently from more or less serious impairment of nutrition, due probably to damage done to the trophic nerves as well as to the blood-vessels. The skin of such parts is often discoloured, and in some cases is hyperæsthetic or painful, and in others more or less numb. It is prone to become inflamed and to ulcerate; and if ulcerated or wounded, healing takes place very slowly as a rule. Protection against exposure to cold and injury should be carefully and constantly afforded.

For the constitutional and general treatment of the frostbitten, *see* COLD, Effects of Severe or Extreme.

ARTHUR E. DURHAM.

FUMIGATION (*fumigo*, I smoke).—

SYNON.: Fr. *Fumigation*; Ger. *Beräucherung.*

DEFINITION.—A mode of employing certain medicinal agents, which are capable of being volatilised by heat, the vapour being allowed to escape into an apartment, or to come in contact with articles of clothing and other objects, for purposes of disinfection; or being allowed to act upon the surface of the body for therapeutic purposes. The chief agents which are thus used are sulphur and mercury.

MODE OF APPLICATION AND USES.—*Sulphur.*—The mode of using sulphur as a disinfectant is explained in the article DISINFECTION. The sulphurous acid may also be brought into contact with the body, sulphur being burnt in a suitable apparatus. It is sometimes thus used for the cure of scabies and other affections.

Mercury.—Mercurial fumigation, general or local, has long been employed in the treatment of syphilis, and many different preparations of mercury have been used in this way.

General mercurial fumigation is now usually effected by exposing the body to the fumes of calomel mixed with steam, the steam being added with the twofold object of inducing gentle perspiration, and of rendering the mercurial fumes less irritating to the respiratory passages. The best form of mercurial vapour-bath is that recommended by Mr. Henry Lee. The apparatus consists of a spirit-lamp which is enclosed in a case of wire gauze, on the top of which is a small plate surrounded by a porcelain trough. One ounce of water is poured into the trough, and the lamp is then lighted. When the water begins to boil, from 20 to 30 grains of resublimed calomel are spread on the plate, and the apparatus is placed between the patient's legs as he sits on a chair undressed, but surrounded by a moleskin cloak long enough to reach the ground. The cloak is tied round the neck, but kept away from the rest of the body by a cane hoop. If it be thought desirable that the vapour should be inhaled, the slit of the cloak may be opened slightly from time to time. The patient should not be alone during the bath, as it sometimes causes faintness. When the calomel is exhausted, which usually takes about a quarter of an hour, the patient goes to bed wearing the cloak as a nightdress. The bath may be repeated every night, or less often, according to the case and the effect produced. The state of the gums must be closely watched, and the dose of calomel regulated according to circumstances.

General mercurial fumigation has been employed in all stages of syphilis, but is probably best adapted for the secondary manifestations, especially the widely spread dry eruptions. It may be tried whenever mercury is not well borne by the stomach. *See* SYPHILIS.

Local mercurial fumigation has been found serviceable in treating obstinate affections of the skin and mucous membrane, in the later as well as in the earlier stages of syphilis. From 3 to 5 grains of calomel is the usual quantity for each fumigation.

GEO. G. GASCOYEN. ARTHUR COOPER.

FUNCTIONAL DISEASES.—A class of diseases in which no anatomical or structural change can be detected to account for their presence. *See* DISEASE, Classification of.

FUNGI, Diseases due to.—*See* PARASITES, Vegetable; and MUSHROOMS, Poisoning by.

FUNGOID (*fungus*, a mushroom).—A term applied to superficial granulations and morbid growths, especially those of a malignant nature, when they sprout rapidly and assume an appearance somewhat like a mushroom. *See* CANCER; and ULCER AND ULCERATION.

FUNGUS-DISEASE OF INDIA. SYNON.: Madura Foot; Mycetoma; *Morbus Tuberculosus Pedis*; Fr. *Dégénérescence Endémique des Os du Pied*; *Pérical.*

DEFINITION.—A diseased condition of the hands and feet, occurring in India, characterised by enlargement and distortion of the affected extremity, due to thickening of the cutaneous tissues, with degeneration and subsequent fracture of the osseous structures. Two forms of the malady are described—the one, the pale or ochroid form, characterised by the presence of minute globular fatty particles like fish-roe, and, though very rarely, by the existence of minute pink concretions not unlike red-pepper granules; the other, the melanoid or dark form, characterised by the existence of black or dark brown masses, varying in size from that of a grain of gunpowder to a walnut, and composed of fungoid filaments, cells, and pigmentary deposit.

DESCRIPTION.—This remarkable disease had not been observed beyond the limits of Hindostan, until a solitary case of it was recorded within the last few years in Italy. In India it has rarely been seen to affect any but natives. No case of a European or half-caste has been recorded as suffering from a typical form of the malady. The foot has been observed to be affected more often than the hand; hence it was common formerly to find the malady referred to as one peculiar to the foot. It has been recognised as a distinctive disease in India for more than thirty years, and was described by Goodfrey, of Madras, in the *Lancet* in 1846, and by Eyre in the *Indian Annals of Medical Science* in 1860. It is to Dr. Vandyke Carter, however, that we are chiefly indebted for what is known of the malady, clinically and pathologically, and his writings date as far back as 1860. His published memoir on the disease (*Mycetoma, or the Fungus-disease of India*, 1874) contains a summary of all that had been written regarding it up to the period of publication. The foot or hand affected with the disease presents appearances not unlike those observed in some forms of caries—especially caries of scrofulous origin. When the foot is affected, it is found to be considerably increased in circumference, the enlargement seldom extending far beyond the ankle; the foot is prone to run in a line with the leg, and may be everted or inverted. It is not, however, in the aspect presented by the limb that the leading peculiarity consists, but in the character of the discharges from the sinuses, the openings of which are scattered all over the surface of the affected tissue. It is this peculiarity which led Dr. Carter to separate the disease into two forms—(1) the 'pale' or 'ochroid,' the discharge of which consists of whitish-yellow roe-like bodies of about the size of millet-seed; and (2) the 'dark' or 'melanoid,' so called from the dark brown or even black granular bodies that constantly escape through the sinuses, not unlike grains of coarse gunpowder. The first form may be said to present two or three varieties, according to the modified character of the discharges; these will be referred to more definitely farther on.

The malady would appear to occur more frequently in Madras, Bombay, and the more westerly and north-westerly parts of India than in Bengal proper. This, however, seems to apply more especially to the dark variety; for, whilst no well-authenticated case of this form has been recorded as having manifestly originated in the last-named province, cases of the pale variety are not infrequent. So far as the foot is concerned, the pale form is apparently the one most commonly met with all over India. As regards the hand, however, this would not seem to be the case, for, whilst the writers have had the opportunity of examining two or three hands affected with the dark variety, they have not seen one affected with the pale; nor can they find any account of such a case having been witnessed. The distortion of the hand affected in this manner is very peculiar—it is shortened and thickened, owing to the destruction of the carpus and metacarpus, and the consequent irregular tension of the extensor and flexor tendons.

ANATOMICAL CHARACTERS.—On our laying open a characteristic specimen of the disease, the bones are found to be extremely softened, so that they can readily be divided by means of a common knife. The interior of the hand or foot is occupied by a series of sharply defined cavities, some quite isolated, but the majority communicating with one another and with the exterior, by a series of complex channels, or sinuses, containing glairy fluid and solid concretions in various proportions. Both cavities and channels are lined by a dense glistening membrane, composed of white fibrous and elastic tissues. The surrounding tissues are generally in a very fatty condition, and, where the disease is of long standing, are more or less completely blended into an indistinguishable mass. So far a common description is applicable to both forms of the disease; but on proceeding to the consideration of the contents of the cavities, great differences present themselves.

Pale form.—The pale or ochroid form is capable of subdivision into several varieties, according to the nature of its morbid products. In the commonest and most characteristic variety the cavities and channels contain masses of spherical bodies like fish-roe, of a pinkish yellow or white colour, surrounded by gelatinous glairy matter. In certain cases, however, the roe-like bodies are almost or entirely absent, and the gelatinous matter and liquid oil are generally diffused throughout the tissues. In a third and very rare variety the section looks as though besprinkled with grains of red-pepper, from the presence of innumerable minute concretions of a bright red hue.

Dark form.—The appearances presented in the dark form of the disease are strikingly different. Here, in place of the roe-like bodies of the previous form, the cavities and channels contain masses of a dark brown or black colour. These masses vary greatly in size, some not being larger than the normal fat-lobules surrounding them, others attaining to the size of a small orange. The larger masses greatly exceed any of the roe-like masses of the pale variety in size, and their consistence is also much firmer than that of the latter. They are tuberculated on the surface, and closely resemble truffles in appearance. On section, they present a more or less distinctly radiating structure, and the interior is generally somewhat lighter in colour than the tuberculated exterior coating. In some cases they are tightly fitted into the cavities in which they lie, but in others they lie loose, and are surrounded by a certain amount of gelatinous matter. The amount of the latter present is, however, much less than in the pale form.

The masses of morbid material in both forms are primarily situated in spaces normally abounding in fat. Long series of them are frequently interpolated among the loculi in the subcutaneous tissue, between healthy fat-lobules; others occupy the interior of the bones; and a third series are developed in the pads of fat lying around muscles and tendons. The muscles and tendons in such cases may frequently be found quite intact, although surrounded by masses of the morbid material. Due to this persistence, fracture and crushing of the softened bones often occur, and it is on this that the distortion of the affected part is in many cases in great measure dependent.

Minute characters of the morbid products. The roe-like particles are composed of a nucleus of granular, waxy consistence, surrounded by a fringe of radiating crystals. They appear to be almost entirely composed of fatty matter, and no traces of the presence of parasitic organisms of any kind can be detected in them. The bright red particles occurring in certain cases of the ochroid form are concretions, consisting in great part of phosphates and carbonates, and containing a considerable proportion of iron.

The dark masses present in the other form of the disease are of much more complex structure. In all, or almost all, cases they contain septate fungoid filaments in greater or less proportion. These are sometimes difficult to distinguish, but may generally be detected by allowing portions of the material to soak for some days in liquor potassæ. The proportion which the filaments bear to the entire mass, when thus separated, is in any case very small, and in some cases extremely so, for on the completion of the soaking only a very small quantity of colourless flocculi, consisting of masses of branched filaments mixed with empty cyst-like cells, is left behind in the fluid. The latter has assumed a brown colour from the solution of the dark mass. The filaments and cysts (*see* the accompanying figure), in so far as tests have yet determined, are indistinguishable from undoubted fungal elements. They are, as a rule, quite empty, and show no signs of growth, or indeed of life. The basis in which they are imbedded

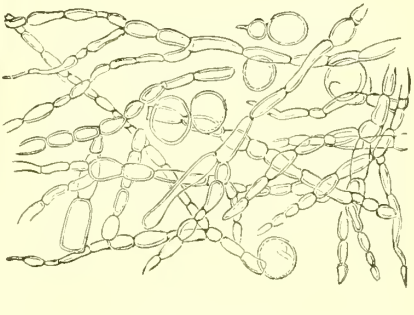

Fig. 58.—Fungoid Filaments and Capsules obtained after prolonged maceration in caustic potash of the dark masses of fungus-disease. × 500.

varies greatly in different cases. In some instances it is soft and contains much oily matter, but in the more advanced cases this is almost absent. It is then only soluble by means of alkalis. The ash consists mainly of calcium phosphate, and is red, from the presence of oxide of iron.

The fungoid filaments have never yet been shown to be capable of any further development. All attempts at cultivation have failed in causing them to assume any form by which their true nature and relationships may be determined. They have never given any unequivocal signs of life external to the body, even when exposed to conditions favourable to the growth of fungi, as demonstrated by the development of various extraneous moulds upon the surface of the black masses themselves, or on the media in which they were immersed.[1]

Symptoms.—Dr. Carter writes: 'As a rule the local indications of this disease are the same for all its forms; for commonly it is not possible to discriminate the several varieties by simple inspection or bare clinical history of the case.' The statements made by the patients as to the mode of origin and progress of these complaints are very various; but, taken generally, they seem to imply that the symptoms are analogous to those usually observed in deep-seated disease of the osseous and adjoining tissues. Eventually a more or less hard lump is felt in the sole of the foot or palm of the hand, or in several places. Generally one or more abscess-like formations occur; and several sinuses are ultimately established, the latter, as a rule, presenting a peculiar mammillated appearance—the 'tubercles,' apparently, of earlier writers. Along with these changes, enlargement and distortion of the affected member take place, but unaccompanied with severe pain. Discharges set in, more or less offensive, according to the nature of the subjacent degeneration, and the limb becomes not only useless, but a burden to its owner. In this manner the sufferer may go on for from one to fifteen or more years, unless relief be sought in a surgical operation.

Course and Duration.—Both forms of fungus-disease run a very chronic course, and often without very materially affecting the general health of the patient; in some cases, however, great emaciation accompanies the disease. With regard to the duration of the malady, it may be stated that cases have been recorded as having existed for various periods up to twenty-six or even thirty years.

Pathology.—The occurrence of the fungoid filaments in the products of the dark variety of the disease has caused many authors to regard them as the essential cause of it. There are, however, good grounds for rejecting such a conclusion. Had the dark form of the disease been the only one with which we were acquainted, there might have been some cause to regard it as due to parasitic agency. When, however, we find that the pale form, whilst causing all the important lesions present in the other, shows a total absence of all fungoid elements in its products, we are forced to regard such elements as of secondary importance. The only means of overcoming this objection would be a demonstration that the products of the pale form are due to a degeneration of the black matter, in the course of which the fungoid elements disappear. No such demonstration has been given, and, on the contrary, it has been shown that each form is capable of running an entirely independent course, the gradual transformation of the normal fat having been traced in the one case to the production of the roe-like particles, and in the other to that of the black masses in which the fungoid elements are imbedded. Were the pale form the only one known, the disease might be described as a mere degeneration of the fatty tissues, with the results consequent on the presence of the morbid products of the process in the surrounding parts; but this explanation, although so far applicable to the dark form, throws no light on the source of the fungoid elements. They are present in masses which are entirely isolated in the tissues, having no communication with one another or with the exterior. There is no evidence of their passage from one cavity to another—on the contrary, they are absolutely limited to the contents of the cavities, the membranous walls of the latter and the intervening tissues never showing any traces of a spreading mycelium, or of any other fungal elements.

Assuming the filaments to be of undoubted fungal origin, the facts point rather to their simultaneous and independent development in multiple centres, than to their spread from one to another. The fact of the necessity of a suitable soil or nidus, in addition to the mere presence of germs, in order to secure the development of organisms, is generally accepted. That germs of most various kinds must constantly be introduced into the blood, is a self-evident fact. Putting their introduction by means of the lungs out of the question, their constant introduction from the intestinal canal can hardly be denied. It can be demonstrated that the intestinal contents abound in vegetable organisms—spores, bacteria, &c.—in a living condition. As it is an ascertained fact that solid particles of inorganic matter of far larger size than many of these germs can enter the circulation, it can hardly be denied that the latter may, and indeed must, enter also. So long as such bodies do not meet with conditions favourable to development, they are no doubt destroyed and utilised by the living matter of the blood and other tissues. If, however, they are deposited in a medium favourable to them, they will grow and undergo such development as they are capable of. The morbid products of the disease here described are practically dead material, external and extraneous to the body, and it has been experimentally demonstrated that, when removed from the body, they form a basis capable of supporting the growth of fungal organisms. Given these two conditions—the constant presence of germs in the circulation, and the possession of a suitable soil for fungi, and the difficulty of accounting for the presence of fungal elements in the latter appears in great part to be removed.[1]

---

[1] The later researches of Dr. Carter and others (*Lancet*, July 2, 1892, p. 18) indicate that Fungus-Disease is identical with Actinomycosis. *See* Actinomycosis.—Editor.

Treatment.—There are no instances recorded of a spontaneous cure having been effected, nor have remedial applications proved of material permanent value in either form of the disease. Removal of all the diseased tissue, by amputation of the affected extremity, is the only remedy which meets with general approval. The subsequent treatment resolves itself into that of an ordinary surgical operation.

D. D. Cunningham. T. R. Lewis.

FUNGUS HÆMATODES (*fungus*, a mushroom; αἷμα, blood; and εἶδος, form).—A synonym for soft malignant growths, which are exuberant and highly vascular, and therefore peculiarly liable to bleed. *See* Cancer; and Tumours.

FURED, in Hungary.—Weak alkaline saline waters. *See* Mineral Waters.

FURFUR (Lat. bran).—A bran-like desquamation of the skin, met with in several cutaneous diseases, more especially pityriasis, psoriasis, and ichthyosis: scurf; dandruff. *See* Skin, Diseases of.

FURFURACEOUS (*furfur*, bran).—A term applied to conditions in which the epidermis is shed in the form of bran-like scales. *See* Furfur.

FURUNCULUS (Lat. a little rascal, dimin. of *fur*, a thief).—A synonym for boil. *See* Boil.

G

GADFLY.—The popular name for a genus of insects whose larvæ infest man and the lower animals. *See* Œstrus.

GALACTAGOGUES (γάλα, milk; and ἄγω, I move).

Definition.—Agencies which increase the secretion of the mammary gland.

Enumeration.—The most common galactagogues are: Mental Emotions; Local Nervous Stimulation; Warmth; good Food; Alcohol; Jaborandi; the fresh leaves of the Castor-Oil plant; Tonics; and Electricity.

Action.—When we consider how powerfully mental processes may affect the activity of nerves supplying the secreting structure of glands, we can understand how these may influence the secretion of milk, as of the sweat, the saliva, and the tears. The maternal feelings of joy, as well as the reflex stimulation of the infant's lips, act most rapidly in developing the functions of the breast. Warmth and good diet also play their part in the process. Alcohol in the form of malt liquors, or malt-extract, is a useful adjunct; and so are such tonics as iron, which counteract in some measure the severe drain on the constitutional resources. Little use has yet been made in actual practice of those drugs which are specially credited with galactagogue properties; but we are told on good authority that a poultice made of the fresh leaves of the castor-oil plant, aided by teaspoonful doses of a fluid extract prepared from the same, has a markedly stimulating influence on the mammary secretion. Belladonna is well known to dry up the milk; and jaborandi, which is its antagonist in so many respects, has been shown to have here also a directly opposite effect, and to be a drug of which further use may yet be made when we wish to excite or re-establish the proper functions of the mammary gland.

Robert Farquharson.

GALACTIDROSIS (γάλα, milk; and ἱδρώς, perspiration).—A term signifying milky perspiration. *See* Sudoriparous Glands, Disorders of.

GALACTORRHŒA (γάλα, milk; and ῥέω, I flow).—An excessive flow of milk. *See* Lactation, Disorders of.

GALL-BLADDER AND GALL-DUCTS, Diseases of.—These affections may be considered in the following order: (1) Catarrh; (2) Inflammation and its Results; (3) Stricture; (4) Dilatation; (5) Cancer; (6) Foreign Bodies; (7) Enlargement of the Gall-bladder; (8) Perforation; and (9) Biliary Fistula.

---

[1] See footnote on preceding page.—Editor.

1. Catarrh of the Bile-passages.—This disease very rarely gives opportunities for examination after death. At the period after death at which it is customary to make *post-mortem* examinations in this country, all redness of the duct has usually disappeared; and there are left only swelling and pallor of the mucous membrane, which is covered with a tenacious glassy or purulent secretion. By this swelling and secretion the bore of the duct is often greatly narrowed; and it can be seen that no bile has passed over it for some days, as all colour has disappeared from the affected part of the tube. In judging of this, however, no pressure must have been made upon the gall-bladder during the earlier part of the examination. These appearances are most pronounced in the common duct and the gall-bladder; they are gradually lost in the hepatic duct and its branches in the liver. The process seems most intense at the duodenal end of the gall-duct, and the orifice of the papilla itself is often found plugged by mucus, an appearance which certainly favours the notion that the catarrh is propagated from the stomach and duodenum. This is believed to be the commonest source of catarrh of the bile-ducts. It is also seen in nutmeg-liver and cirrhosis; and a tendency to chronic catarrh is set up by the presence of foreign bodies in the ducts, such as gall-stones.

Symptoms.—Jaundice is often the first symptom which draws the attention of the patient to his health in a case of catarrh of the bile-ducts, although in a certain number of cases this is preceded by symptoms of gastric disorder, such as vomiting or sense of sickness, loss of appetite, and furred tongue; or, on the other hand, by diarrhœa. The jaundice lasts usually about three weeks, sometimes as much as six or eight weeks. After this, suspicion should be aroused whether something more than a simple catarrh be not present.

Diagnosis.—The diagnosis depends upon the absence of any physical signs indicating organic change in the liver; and on the presence of gastric symptoms. Thus nearly all cases of simple jaundice are diagnosticated by some physicians as cases of catarrh of the bile-ducts. As the greater number of the patients recover, very few opportunities are given for verifying this diagnosis; but in those which have been examined, plugs of mucus in the ducts have not infrequently been found. The catarrh caused by gall-stones is lost in the jaundice and pain associated therewith.

Treatment.—The treatment should at first be directed to the gastric symptoms, beginning with a purgative, followed by a course of effervescing alkaline medicines, and restricted diet. Later on, dilute nitro-hydrochloric acid taken before meals is often very useful. Daily enemata of one or two quarts of water, at a temperature of from 60° to 90° F., to be retained as long as possible, have been recommended.

2. Inflammation and its Results.—In some cases of typhus and typhoid fever, and in other typhoid states, the gall-duct and gall-bladder become *ulcerated*, or filled with purulent fluid, or covered with *croupous exudation*. The same thing may happen when gall-stones are impacted in the ducts. The gall-ducts are sometimes *obliterated* by fibrous bands passing over them. Sometimes they suffer a congenital obliteration by the over-growth of the fibrous tissue around them.

3. Stricture.—Stricture of the gall-duct is occasionally met with. Usually it is associated with the presence of gall-stones. It would seem most probable that it arises from inflammation and ulceration of the duct produced by the transit or impaction of calculi. On the other hand, it is possible, though not probable, that it may be primary, and by impeding the escape of bile give rise to gall-stones. Stricture of the gall-duct causes dilatation of the ducts or gall-bladder behind.

4. Dilatation.—The gall-ducts and gall-bladder become dilated whenever there exists an obstruction, either pressing on the ducts from the outside, or formed within them. The first result is dilatation of the ducts behind the obstruction. The gall-bladder becomes much dilated, often filled with a thick green bile. If the obstruction last long, the coloured part of the bile is absorbed, and its place taken by a colourless fluid, either viscid or limpid. This fluid contains neither bile-pigment nor bile-acids, is often albuminous, and contains abundance of mucus. The ducts outside the liver may be enormously distended. It is common to see them as big as the middle finger. Within the liver they are also dilated, but not to so great a degree; and they are more dilated on the left than on the right side. The dilatation of the ducts may become cystic, and sometimes moniliform. The writer (J. W. L.) has always been able to find columnar epithelium in these dilated ducts. In some cases of long-continued obstruction, the contents of the bile-ducts become colourless; in other cases, purulent; and small abscesses form around the bile-ducts, and open into them. These abscesses may be multiple; or, more commonly, only a single large one is formed. The abscess or the dilated gall-ducts may rupture into the peritoneum, and cause fatal peritonitis.

5. Cancer.—Primary cancer of the gall-ducts and gall-bladder is sometimes met with; or they may be affected secondarily.

6. Foreign Bodies.—Foreign bodies are occasionally met with in the gall-ducts. The most common of all are, of course, *gall-stones*. Much less common are entozoa, such as the *Distoma hepaticum*, *hydatids*, or the two kinds of *ascarides*, especially lumbrici.

Symptoms.—In all these different morbid states it is usually only possible to say at the bedside that the large bile-ducts are obstructed; a more complete diagnosis is commonly impossible. Jaundice is an important symptom, as without it disease of the bile-ducts cannot be diagnosticated. It is commonly very intense, the urine being deeply coloured, and the fæces quite colourless. The enlargement of the liver, if present, is commonly uniform, the surface being smooth, and the edges well-defined. The gall-bladder may often be felt at the edge of the right lobe as a rounded tumour; this is then a sure sign of the obstruction of the gall-ducts. In simple diseases of the gall-ducts there is an absence of splenic tumour, of ascites, and of other symptoms of portal obstruction. In many cases, however, diseases of the liver and of the gall-ducts are so intimately bound up together, that they cannot, during life, be separated.

Prognosis.—The prognosis, if simple catarrh of the gall-ducts and gall-stones can be excluded, is unfavourable.

Treatment.—The treatment must be conducted on general principles.

7. **Enlargement of the Gall-bladder.** The gall-bladder cannot be felt in health during life. But it may often readily enough be made out where there exists any obstruction in the common or cystic duct, so that it becomes distended with fluid. It may also be felt when the walls become fibrous or calcified, or the seat of cancer; or when its cavity is filled with gall-stones. A tumour may then be felt under the border of the right lobe of the liver, in the situation of the gall-bladder. When filled with fluid, a rounded, sometimes oblong, sometimes pear-shaped tumour is felt; in other cases it has an irregular shape, or a somewhat rounded outline. The gall-bladder usually enlarges in a direction obliquely downwards and forwards in a line which, drawn from the tenth costal cartilage, crosses the middle line a little below the umbilicus (Mayo Robson). A greatly distended gall-bladder has been mistaken for ascites, and tapped. The diagnosis depends chiefly on the situation of the swelling, and even then the distended gall-bladder may be mistaken for hydatid disease of the liver-substance or of the omentum, or for a tumour of a neighbouring organ, especially the right kidney, which has pressed against the liver. The difficulty of the diagnosis is much increased if the liver be moved from its natural place, for then the position of the gall-bladder becomes uncertain. Bamberger says he has often mistaken a softened cancerous nodule of the liver for a distended gall-bladder. If it be certain that a fluctuating tumour be the gall-bladder, and no jaundice be present, a diagnosis may safely be made of *hydrops cystidis felleæ*, or dropsy of the gall-bladder; but if jaundice be present, or if the tumour do not fluctuate but appear solid, there are then no definite rules for diagnosis: all depends upon the surrounding facts of the case. Dropsy of the gall-bladder is not a dangerous disorder, and requires no treatment; while the prognosis and treatment of the other states depend entirely on their respective causes. Surgical treatment is now extensively employed.

8. **Perforation.**—Perforation of the gall-bladder or of the gall-ducts is generally the result of ulceration, due to gall-stones, inflammation, and other causes. Fatal peritonitis ensues if the perforation occur into the abdominal cavity. Frequently, however, previous adhesions have been formed between the biliary reservoir or duct and the neighbouring organs, as the intestine, or the abdominal wall, and the result of this is—

9. **Biliary Fistula.**—This may exist between the gall-bladder or gall-ducts and the surface of the body, the stomach, colon, or duodenum. Very rarely gall-stones find their way into the urinary tract.

J. Wickham Legg. Stephen Mackenzie.

GALL-STONES. — Synon.: Hepatic Calculi; Cholelithiasis; Fr. *Calculs biliaires*; Ger. *Gallensteine.*

Description.—Gall-stones are seen in man and most of the vertebrate animals, and in some molluscs. They are especially common in oxen. They are found in the biliary passages; most usually in the gall-bladder, or the cystic and common duct; more rarely in the hepatic duct, and in its branches within the liver. They vary in size from fine gravel to concretions five inches long. The largest are commonly single, and then they are rounded or oval in shape. The smaller calculi are usually numerous, being then tetrahedral or wedge-shaped, showing the facets or plane surfaces caused by mutual pressure or friction. They are never lighter than water when first removed from the body. Only after drying do they float. Their consistence when raised to the ordinary temperature of the body becomes much less, so that they can be moulded by the fingers. Their colour varies from white to almost black; most commonly it is brown.

Dr. Thudichum thinks that the nuclei of gall-stones are mostly formed of casts of the hepatic ducts. There is rarely more than one nucleus. Its chemical composition is a compound of lime and bile-pigment, or traces of mucus and phosphatic earths. The chief chemical constituent of human gall-stones is cholesterin; some gall-stones are wholly composed of this substance; most contain 70 or 80 per cent. Other constituents of gall-stones are the bile-pigments, either by themselves or in combination with lime. Very small quantities of the bile-acids are found, and these are also in combination with lime. It is rare to find gall-stones with any large amounts of carbonate or phosphate of lime, though the ash of nearly all gall-stones shows a large amount of carbonate of lime, the product of the combustion. Traces of copper, iron, and manganese are found in nearly all gall-stones. Lime-salts of the fatty acids are likewise found.

Ætiology.—Age has an apparent influence in the production of gall-stones: they are exceedingly rare in infancy and childhood, their frequency increases after the age of puberty, and they become still more common after thirty. Women are thought to be more liable than men to gall-stones. In cancer of the liver, gall-stones are certainly very commonly found, while on the other hand in cirrhosis they are scarcely ever seen. Want of physical exercise and indulgence in rich diet seem to favour their production.

Pathology.—What is the cause of the first formation of a gall-stone? It is not simply concentration of the bile, since the cholesterin and pigment remain in solution so long as the bile is unchanged; but the beginning of decomposition of the bile-acids causes a precipitation. The cholesterin is likewise thrown down when the reaction of the bile changes from alkaline to acid. Gorup-Besanez and Dr. Thudichum have kept bile several months, and found the reaction at the end of that time acid, with an abundant sediment. It is thus probable that the retention of bile in the gall-bladder or gall-ducts favours the formation of these concretions. It is also probable that gall-stones may be dissolved spontaneously, as erosions are sometimes seen on them; or they may break up, and thus pass out.

Symptoms.—Gall-stones while still in the gall-bladder rarely give any signs of their presence. They are frequently found in the gall-bladders of persons who during life had no symptoms which could be referred to the liver. It is when they begin to leave the gall-bladder, and escape into the cystic and common duct, that symptoms arise of gall-stone colic. They often begin with a dull pain near the liver, with vomiting, rigors, and elevation of temperature; or, quite suddenly, a severe pain in the right hypochondrium comes on, described as shooting, stabbing, burning, &c. The pain extends into the epigastrium, rarely to the left hypochondrium, to the right shoulder, and, according to some, even into the extremities. The pain is very intense, and may give rise to delirium and convulsions in nervous persons, or to hysterical attacks in women. Vomiting is usually present; and, as the attacks most often come on after eating, at first only the food taken is thrown up, and then a colourless mucus. The right hypochondrium is usually very tender, and the muscles are rigid. The pulse, as a rule, is not increased in frequency, being indeed rather below than above the natural number. In violent attacks the pulse becomes very frequent and small, or almost imperceptible; the eyes are surrounded with dark marks; the nose is pointed; the breath is cool; and cold sweats break out over the body. In this state death may occur, but it is a rare event. A few hours after the attack, the conjunctivæ may show a yellow tinge, which will gradually spread from the upper part of the trunk all over the body. The jaundice is more or less intense according to the shape of the gall-stone—whether completely obstructing the duct, or merely causing a hindrance to the passage of the bile. In some cases jaundice may be altogether wanting, as when the stone is in the cystic duct. The jaundice may last an indefinite time. The duration of the attack of colic itself varies: usually not lasting more than a few hours, it may extend over several days. As soon as the gall-stone reaches the duodenum the attacks are over, the stools become dark, and the jaundice begins to disappear. When the gall-stones reach the intestine, they are commonly evacuated with the fæces; some cases have, however, been recorded in which they were so large that symptoms of intestinal obstruction were caused and death resulted. A gall-stone ulcerating its way into the intestine may give rise to hæmorrhage from the bowels. Other rare symptoms are occasionally associated with gall-stones, as intermittent pyrexia, glycosuria, and enlargement of the spleen.

Diagnosis.—The diagnosis of gall-stones is often more or less difficult. Some physicians think that the diagnosis should not be made unless the concretions be found in the stools; and the search for them should be made by passing the fæces through a sieve. It is thought by many that it cannot be made if there be no jaundice present. On the other hand, it has been proved that severe and even fatal attacks have occurred without the occurrence of jaundice or discoloration of the fæces. Recurrent attacks of severe 'spasm' in the right hypochondrium or epigastrium should awaken a suspicion of gall-stones, even if no jaundice follow the attacks. Persistent jaundice is characteristic of cancer rather than of gall-stones, though the two may co-exist. Cancer of the head of the pancreas may readily be mistaken for gall-stones in the common duct.

Prognosis.—It is almost impossible to make a trustworthy prognosis in these cases. The physician can never speak confidently, or feel quite happy when treating a case which he looks upon as one of gall-stones.

Treatment.—The treatment of gall-stones may be discussed under two heads: during the paroxysm of the colic; and between the attacks.

During the paroxysm the object is to relieve pain. This may best be done by full doses of morphine; and if this be rejected by vomiting, it may be administered hypodermically. Belladonna may also be used. The patient may be put in a warm bath and kept there, the heat being maintained by the renewal of the warm water. Should these means fail, chloroform or ether may be inhaled.

Between the attacks of biliary colic dieting is of great importance. Limiting, or practically excluding, saccharine and fatty matters sometimes leads to the cessation of attacks, which were previously frequent. A great number of remedies have been proposed: the most popular is Durande's, which consists of three parts of ether and two parts of turpentine; the best plan is to give 10 to 20 minims of this mixture three times a day, enclosed in capsules or pearls. The German physicians have great confidence in the alkaline mineral waters, especially Carlsbad. Some think the benefit is due simply to the large amount of water daily ingested, causing a large flow of bile. Lately, an old plan of treatment has been revived—namely, the administration of large doses of olive oil, as much as six to twelve ounces being given for a dose. Following the administration of the oil, numerous concretions have been found in the stools, which have been mistaken for gall-stones. They have, however, been proved to consist of neutral fats and free fatty acids, with a small proportion of cholesterin. Though the oil does not soften and bring away gall-stones as imagined, yet undoubted relief is sometimes afforded, with diminution in the size of the swollen liver. Dr. George Harley advocates extrusion of gall-stones blocking the ducts by digital manipulation. The obstruction has, in some cases, been overcome by this means, but it is treatment which should be carried out only with great care and gentleness, as the gall-duct, inflamed, softened, and ulcerated by the presence of a stone, might be ruptured by too forcible manipulation. In cases of enlarged gall-bladder from gall-stones, or repeated attacks of severe pain in the hepatic region, with or without jaundice or suppuration of the gall-ducts, the aid of a surgeon should be obtained, with a view to an exploratory operation or cholecystotomy. The cases recorded where this and other operations on the gall-bladder and ducts have been performed justify a hope that in future many lives will be saved which would without operative interference be lost. Other kinds of treatment recommended are by purgatives, as castor oil, or by taraxacum or diluted nitro-hydrochloric acid. Emetics have been employed, but they are dangerous on account of the straining which they cause, and which may lead to the rupture of a vessel.

J. Wickham Legg. Stephen Mackenzie.

GALLOPING CONSUMPTION. A popular name for phthisis when it runs an acute or rapid course. *See* Phthisis.

GALVANISM, Uses of.—*See* Electricity in Medicine.

GANGLION (*γάγγλιον*, a hard gathering).—This term is applied to a variety of somewhat different affections, including: 1. The *simple* ganglion. This is a cystic tumour formed in connexion with the sheath of a tendon. 2. The *compound* or *diffuse* ganglion, which consists of a chronic effusion into the common sheath of a group of tendons, giving rise to a fluctuating swelling. One variety of this contains the so-called melon-seed-like bodies. 3. The term is extended by some writers to enlargements of the bursæ mucosæ. *See* Bursæ, Diseases of.

1. Simple Ganglion.—Description.—The simple ganglion forms a rounded tumour, occasionally lobulated, in the immediate neighbourhood of some tendon. The most common situations are the dorsum of the hand, the dorsum of the foot, the palm of the hand at the root of a finger, and behind the outer or the inner malleolus. The tumour varies in size from a pea to a pigeon's egg. It may fluctuate distinctly, or be so tense as to seem solid. It is not adherent to the skin or to the tendon with which it is in relation. It is painless, but often gives rise to a sense of weakness in the affected part. The wall is composed of a more or less delicate fibrous tissue, fusing with the surrounding areolar tissue, and lined by an imperfect layer of endothelial cells. Its contents are most usually semi-solid, like apple-jelly, but sometimes fluid; they are said to be neither albuminous nor gelatinous, but colloid in character. As to the exact nature of the tumour opinions differ, and probably it is not always the same. It is said to arise in the following ways: 1st. By a hernial protrusion from the sheath of a tendon, the neck of which becomes gradually contracted and finally closed, so giving rise to a cyst in intimate connexion with the sheath. 2nd. Gosselin has described small follicles or sub-synovial crypts, which he believes may become dilated, so as to form ganglia. 3rd. The tumour may be a cyst of entirely new formation.

Treatment.—Painting with iodine is of little or no use. Forcible rupture of the cyst by a blow or pressure sometimes effects a cure. The best treatment is to puncture the tumour with a clean grooved needle, and to squeeze out the contents, afterwards applying pressure or a blister over the collapsed cyst. This treatment may require to be repeated more than once.

2. Compound or Diffuse Ganglion.—Description.—This disease is almost exclusively confined to the sheath of the common flexors of the fingers. It may consist of a simple dropsy of this sheath, forming an hourglass-shaped swelling in the front of the wrist, the constriction being caused by the annular ligament; or, in other cases, the tumour may contain melon-seed-like bodies, which give rise to a sense of soft crackling when it is manipulated. These melon-seed bodies are smooth, oval and flattish in shape, and of a pearly-white colour. They are of almost cartilaginous toughness, and on section present an appearance of concentric lamination. Under the microscope they are found to be composed of very imperfect fibroid tissue. Their origin is somewhat doubtful. They have been supposed to be due, first, to hypertrophy of the fringes normally found on a synovial membrane, the pedunculated projections so formed being ultimately broken loose by the movement of the tendons; secondly, to the formation of pedunculated warty outgrowths on the synovial membrane, which become free in the same way; thirdly, to fibrinous deposits taking place from the fluid in the ganglion; and, fourthly, to the results of accidental hæmorrhage. When these bodies are abundant, the fluid is usually scanty.

Ætiology. — Recent observations have shown that in the great majority of cases, if not in all, the compound ganglion of the wrist is a chronic tubercular affection of the synovial membrane. Many cases have been recorded in which it was associated with tubercular disease of the carpus, but which was the primary affection is not certain.

Treatment.—The treatment of compound ganglion is unsatisfactory. Iodine is useless. Aspiration followed by the injection of iodine has occasionally been of service. An incision made into each end of the tumour, followed by drainage under antiseptic dressing, is often of use. In extreme cases Syme recommended laying the whole cavity open, and allowing it to granulate. This always left much stiffness in the tendons. When melon-seed bodies are present, they must be removed by incision, and the case treated antiseptically, as septic suppuration would almost certainly lead to implication of the wrist-joint. Marcus Beck.

GANGLIONIC NERVOUS SYSTEM, Diseases of.—*See* Sympathetic System, Diseases of.

GANGRENE (γραίνω, I corrode).—Synon.: Mortification; Sphacelus; Fr. *Gangrène*; Ger. *der Brand.*

Definition.—Gangrene is the arrest of the functions of organic life in a circumscribed portion of the soft parts of the body, leading to the complete death of the same. It implies destruction of a considerable area of tissue *en masse*, as distinguished from molecular disintegration or ulceration.

The whole process of death is included under the term 'gangrene'; the result being mortification, sloughing, or necrosis of the invaded tissue, organ, or limb.

Classification. — *Clinically*, gangrene varies greatly according to its position, cause, extent, the powers of the patient, and the existence of complications. The disease may also be classified *ætiologically* and *pathologically* into *spontaneous* or *traumatic*, *dry* or *moist*, *chronic* or *acute gangrene*, *senile gangrene*, and *hospital gangrene.* The division into dry and moist gangrene, although convenient, has little pathological significance, being founded on physical characters. Both dry and moist gangrene may arise from similar causes, and coexist even, in different parts of the invaded structures; and it cannot always be predetermined whether a gangrene shall be of the dry or of the moist form. Dry gangrene is usually dependent on senile changes, chiefly arterial degeneration; and is more limited in extent, and chronic in progress. The parts first affected, having time to dry up as the disease invades those adjacent, become mummified, hard, and black, resembling the knuckle of a Spanish ham. Moist gangrene occurs from venous obstruction; and when a large area of living tissue suddenly mortifies, more especially if it have been previously inflamed or gorged with fluid, the dead parts become rapidly transformed into a deliquescent putrid mass, infiltrated with gas. To this type belong many different forms of gangrene—for instance, that following the obliteration of the main artery or vein of a limb, or their becoming plugged by embolus; or the form called *spreading traumatic gangrene*; or gangrene affecting an internal organ.

Ætiology.—The causes of gangrene may be local and constitutional, or a combination of both. Amongst *local* causes we find intense inflammation of some organ or tissue, such as occurs in pneumonia, noma, cellulitis, anthrax, or phlegmonous erysipelas. Injuries and mechanical violence of various kinds, caustics, and extremes of heat or cold, as seen in burns and scalds or in frostbite, also lead to gangrene. Gangrene may be produced either as the direct consequence of the long-continued application of cold, or as the result of the subsequent inflammatory reaction. Local arrest of the circulation, as in a limb whose main blood-current is arrested by injury, the application of a ligature to an artery or embolic plugging, a strangulated hernia, an intussusception, or internal strangulation, a ligatured hæmorrhoid, a too tightly bandaged limb, or severe paraphimosis, may lead to gangrene. It may also occur from extravasation of urine or fæces. Continued pressure produces a variety of gangrene called *bed-sore*, especially in lowly vitalised parts, and in persons suffering from chronic diseases, or from certain lesions of the nervous centres. *See* Ulcer and Ulceration.

One of the most frequent *constitutional* or *general* causes of gangrene is deficient blood-supply to the part, dependent upon chronic disease of the arteries, the result of arteritis or degenerative senile changes, whence the term *senile gangrene.* Gangrene may occur in the course of certain diseases, as diabetes, typhus, typhoid, measles, and scarlatina; embolism being in many cases the immediate cause of the complication. The gangrene due to ergotism is probably induced by the effect of the poison on the blood-vessels. A peculiar form of gangrene sometimes met with in the extremities—the *gangrène symétrique* of the French—is one in which no more definite cause can be found than anæmia and an extremely feeble circulation. Loss of nerve-influence is also a cause of gangrene. Acute spreading traumatic gangrene is a manifestation of a hyperacute form of septic infection. And, finally, there is *hospital gangrene—pourriture d'hôpital*—a disease seldom met with now except amongst wounded soldiers accumulated in great numbers in foul hospitals near a battle-field, contagious in nature, and due to a specific septic agency. *See* RAYNAUD'S DISEASE.

SYMPTOMS.—The symptoms of gangrene vary with the species, the extent, and the stage of the disease, and with the rapidity of its progress; and also according as it is dry or moist, incipient or complete. The importance of the tissue or organ invaded, and the presence or absence of complications, such as renal or cardiac disease, or of fever, also create differences.

The earliest symptoms are those of diminished circulation, sensibility, and temperature, together with change of colour in the part affected. Pain is one of the primary symptoms, and often precedes the others. In dry, senile, or chronic gangrene there may in some cases be few symptoms beyond moderate local pain and discomfort, though oftentimes the pain is intense; whilst, when the type is of the moist or acute variety, the symptoms are usually more severe, and have a tendency to lapse into those called typhoid or septicæmic. Between these two forms there is every intermediate grade of severity. The amount of fever varies at the outset, but it is usually considerable. The patient generally suffers much from pain, restlessness, and want of sleep; the appetite is bad; the tongue is loaded; and the pulse is feeble or intermittent. When the disease becomes arrested, the dead portion of tissue slowly separates and drops off, or is removed; very often, however, the disease steadily progresses, and the patient dies from exhaustion, or more rapidly from the absorption of septic matter.

Such being the principal symptoms of gangrene in general, we may next describe the symptoms of the leading varieties of the disease.

Dry or Chronic Senile Gangrene.—In the dry form of senile gangrene the part is gradually starved to death by reason of the diminished blood-supply. Embolic plugging may also produce the dry variety. The arterial current is suddenly arrested, while the veins empty the blood from the limb. The limb becomes whitish-mottled and shrunken, then brown and black. Senile gangrene generally occurs in the toes, very rarely in the fingers; and is either spontaneous or excited by some trivial cause. A discoloured patch appears on one of the toes, of a dusky reddish-brown colour, which soon becomes dry and black in the centre. The disease spreads very slowly to the adjacent parts. First, a zone of discoloration appears, from the blood stagnating in them; then they become livid, red, and inflamed; afterwards darker; and, finally, black and dry. One or several toes may be involved, or the foot in whole or in part. The patient generally dies sooner or later, exhausted by pain, and from general feebleness of the vital powers. Sometimes a line of demarcation appears, the dead parts separate, and recovery follows; but as a rule relapses take place.

Moist or Acute Senile Gangrene.—This form of senile gangrene is more active in its progress, and more rapidly fatal. It is often ascribed to some slight local irritation or injury, such as an inflamed corn or nail. The affected toe becomes dusky-red, swollen, and extremely painful; soon after the dark hue of absolutely dead tissue appears, following closely the zone of inflammation; and this gradually spreads onwards, till the whole foot or possibly the leg, if the patient survive, becomes implicated. Beyond the gangrenous area the skin is mottled, and presents all the appearances due to impeded circulation. In this type of gangrene, stasis of the blood and coagulation first take place in the capillaries, and extend thence to the smaller arteries. It occurs in elderly persons with feeble circulation, due to fatty heart and atheromatous arteries. Diabetic gangrene is commonly of this form.

Gangrene from Arterial or Venous Obstruction.—The most common form of moist gangrene is that due to sudden arterial obstruction of a large vessel, when the collateral supply cannot establish itself with sufficient rapidity. It is acute; and a large portion of the body being at once engaged, the tissues do not, as in dry gangrene, have time to desiccate *pari passu* with the spread of the disease. It may happen after ligature of a main trunk for aneurysm; or by the impaction of a fibrinous clot formed upon the roughened wall of an atheromatous vessel, and consequent plugging of the artery, or by embolism. This form of gangrene often assumes the dry character. An entire extremity may be thus affected. Venous obstruction does not produce gangrene unless complete. Collateral venous channels usually take the place of obstructed ones with ease. In cases due to embolism—a form rare in the upper limbs, but common in the lower extremities, and more especially at the bifurcation of the tibial arteries—sudden and severe pain marks the onset of the disease. The temperature of the part rapidly falls; livid discoloration and loss of sensibility ensue; the blood stagnates in the veins; the skin mottles; bullæ form, filled with turbid fluid; the colour changes from whitish-grey to green, olive, or black; and the affected tissue at length becomes a deliquescent putrid mass, often crepitating from gas imprisoned in the meshes of the cellular tissue. The tendons, blood-vessels, nerves, and bone resist the disintegrating process longest.

Gangrene from Inflammation. — Gangrene as the result of intense inflammation is likewise of the moist type. When it supervenes, the tension, pain, and swelling of the inflamed area subside; the part becomes soft and doughy; the colour changes into dusky violet, brown, or black; and all the evidences of rapid decomposition, varying with the part affected and the acuteness of the inflammation, make their appearance.

Gangrene as a Complication of General Disease.—Gangrene is occasionally met with in the later stages of typhoid fever, or even during convalescence; and usually occurs in the lower limbs, though sometimes in the face or in the lungs. It is of vascular origin, and is a most grave complication. In form it may be either dry or moist, and may be of either of two kinds. One is of early occurrence in the progress of the disease, and generally affects the toes symmetrically; the other occurs later, or during convalescence, and is of embolic origin.

Measles is prone in some cases to occasion gangrene, generally affecting the face, the vulva, or the lungs. Scarlatina and some forms of erysipelas are also occasionally followed by extensive gangrene. The disease has been also observed during some epidemics of cholera. Gangrene produced by the prolonged consumption of diseased rye-bread chiefly occurs in the male adult, and very rarely in women or children. Other symptoms of ergotism will then be present, gangrene being a late occurrence. Gangrene from ergotism precisely resembles ordinary senile gangrene. It almost invariably appears in the lower limbs; and when a line of demarcation forms, this generally seems to correspond with the nearest joint. In diabetic gangrene no special vascular deficiency can be traced. The vitality of the tissues seems impaired by the glycosuric condition, and some slight accidental cause provokes a gangrenous inflammation.

Hospital Gangrene.—Hospital gangrene presupposes a wound. The lesion on invasion ceases to discharge, and becomes covered with a grey tenacious slough extending from the centre towards the edges, which become much inflamed and everted. The patient rapidly lapses into a typhoid condition; and the issue is generally fatal.

Acute Traumatic or Spreading Gangrene. This form also follows upon an injury, which may be either slight or severe. It is generally seen in one of the extremities, originating in a wound and rapidly spreading towards the trunk—*gangrène foudroyante.* It is in many cases intimately associated with, and probably induced by, septic infection ot the system. It is usually fatal, and scarcely amenable to any treatment short of very early amputation.

Visceral Gangrene.—The gangrene of internal organs will be found described in connexion with the diseases of the several organs.

PROGRESS.—The progress of gangrene dependent on constitutional causes is too often from bad to worse; and a fatal issue may supervene without any attempt at repair. The gangrenous inflammation, preceding the actual death of the part, continually invades fresh tissues; the fever increases; a sallow sunken countenance, with rapid thready pulse, sordes, muttering delirium, tympanites, hiccough, subsultus, scanty loaded urine or even suppression, supervene; the weakness increases; and death, preceded by collapse, takes place.

In other cases, especially those dependent on local causes, there is a tendency to limitation; and the process by which this is accomplished is the same for all kinds of gangrene, in every part of the body. In superficial structures a red band of healthy inflammation will be observed at the junction of the living with the dead part, called the *line of demarcation*; active cell-infiltration takes place; and a separating wall of fibrin and young cells is established in the layer of living tissue nearest to the dead structures. This becomes by degrees converted into an ordinary granulating surface, and the dead tissue is detached and cast off. The time required for this separation varies with the bulk of the dead portion, the nature of the tissue, and the vitality of the individual. The risk of septicæmic poisoning is present throughout the entire course of the disease.

DIAGNOSIS.—The diagnosis of gangrene of external parts cannot be attended with any difficulty; the evidence of its presence being readily appreciated when the symptoms already described make their appearance.

PROGNOSIS.—The prognosis of a case of gangrene will mainly depend on the likelihood of the disease becoming limited, the strength of the patient, and the conditions in which he is placed; which are all at first difficult to determine. The cause of the gangrene, and the presence or absence of organic mischief elsewhere, also exercise a great influence. When the malady is dependent on a constitutional cause, there will be little tendency to delimitation and a bad prospect of recovery. When the cause is local, and the destruction of tissue neither extensive nor invading a vital part, the prognosis will be favourable. But a local injury, when the conditions are unfavourable, may be followed by a severe and extensive gangrene, or some essential part of the body may become implicated.

TREATMENT.—When gangrene is imminent, our first care should be to adopt means to support the vital warmth of the part, and to encourage and relieve the embarrassed circulation. When the disease is fully developed, our attention must be directed to control as far as practicable the spread of the disease; to favour the separation of the dead tissue; and to keep the parts as clean and harmless as possible. We must also anticipate complications, or combat them when they occur; and support the patient's strength by good food, stimulants, and fresh air, together with opiates sufficient to allay pain. A limited traumatic gangrene is to be treated as an ordinary sloughing wound. If a complete portion of a limb be involved, amputation should be performed as soon as the line of demarcation is established. In gangrene due to arterial obstruction, the extremity should be raised to assist the return of venous blood; antiseptic dressings and cotton-wool applied locally; and plenty of bland food administered at frequent intervals. When the whole limb is affected, nature may be assisted by completing the amputation of the part as soon as the limiting line is distinct. In gangrene caused by the ligature or rupture of a main artery, or the pressure of an aneurysm, amputation close to the seat of the lesion may at once be performed, as the gangrene will not extend higher than this point; but even under these circumstances it may often be safer to await indications of a commencing demarcation than to amputate previously. In spreading traumatic gangrene early amputation of the affected limb has been strongly recommended; but as this cannot remove the already poisoned condition of the blood, upon which in all probability the gangrene depends, it is generally a useless measure, as the gangrenous action would invade the stump. It affords, however, the only possible chance. In senile gangrene amputation is sometimes indicated, and the dead parts may be removed near to the demarcating line; but an amputation higher up, as in the thigh, has been advocated, where the prospects of repair due to the more vigorous circulation will be presumably better. In cases where traumatic gangrene is localised and dependent merely upon the violence of the injury, the vitality of the individual will be sufficient to neutralise the mischief, unless it be very extensive. A line of demarcation will appear, and then, but not before, will it be proper to amputate, unless the part be otherwise hopelessly injured, or a large articulation opened, when immediate amputation is indicated.

For the treatment of gangrene occurring in internal organs the reader is referred to the articles on the diseases of the several viscera.

WILLIAM MAC CORMAC.

GARGLE (γαργαρίζω, I wash the throat).—SYNON.: Fr. *Gargarisme*; Ger. *Gurgelmittel*.

DEFINITION.—Gargles are liquids employed for the production of local effects on the throat and pharynx.

MODE OF GARGLING.—Gargling consists in taking about a tablespoonful, more or less, of the gargle into the mouth, throwing back the head, and agitating the liquid by the air expelled through the larynx. With some persons the gargle goes little beyond the uvula and base of the tongue; but if the head be thrown well back, the fluid can be made to pass into the cavity of the pharynx, and may even reach the larynx and vocal cords. The tension of the muscles, in thus throwing back the head, is apt to provoke efforts at deglutition, so that sometimes small portions of the gargle may be swallowed; and occasionally the effort terminates abruptly in the patient jerking his head forwards, and expelling the gargle forcibly through the nose.

Dr. H. Guinier, of Cauterets, has demonstrated a method of gargling the laryngeal cavity. His instructions are as follows: (1) Slightly to raise the head; (2) to open the mouth moderately; (3) to protrude the chin and lower jaw; (4) to emit the sound of the double vowel *æ*. These four movements open largely the back of the mouth, lift the velum palati and uvula, separate the base of the tongue from the posterior wall, and allow the liquid used for gargling to gravitate into the cavity of the larynx. One expiratory act is the only respiratory movement that is now possible, deglutition is under control, and the gargle bathes the pharynx and supraglottic portion of the larynx. When it is desirable to gargle the back of the pharynx and posterior nares, the patient must take a mouthful of the gargle, and use it as he lies flat on his back with his tongue drawn forward.

USES AND COMPOSITION.—The use of gargles is contra-indicated in parenchymatous inflammations of the tonsils, and in all cases where movement of the fauces causes severe pain; and where, as in some persons, an inability exists to retain liquid beyond the anterior pillars of the fauces: for these it is more convenient to apply the fluid to the fauces and pharynx, either by injection, or in the form of a medicated spray, or else by aid of a brush or sponge.

Gargles vary in composition according to their object. If prescribed with the view of exercising the muscles of the soft palate and pharynx, and thereby increasing their tone, cold or iced water is generally sufficient. If with the view of reducing and allaying local inflammatory conditions of the throat, solutions of chlorate or nitrate of potassium or of borax (two drachms to eight ounces), or of solution of acetate of ammonium (one part in four), combined with infusion of linseed, thin gruel, or water, and used warm, are the best. When it is desirable to excite the mucous membrane and neighbouring glands to further secretion, and thus reduce local congestion, stimulant gargles are useful, such as the tinctures of capsicum (half a drachm to eight ounces), arnica, myrrh, pyrethrum, and eucalyptus rostrata (two drachms to eight ounces); this class of gargles often relieving the deafness caused by obstruction of the Eustachian tubes, by increasing the pharyngeal secretion. To check excessive secretion, astringents are advisable in the form of the salts of iron and zinc, iron-alum or alum (forty grains to eight ounces), tannin (half a drachm to eight ounces), or infusion of rhatany. If we require to check ulceration, or to dilute and purify foul or putrid secretions from the throat and tonsils, antiseptic gargles will answer the purpose, composed of one or two drachms of liquor potassii permanganatis to a pint of water, or one drachm of solution of chlorinated soda to half a pint of water, or sulphurous acid one part to four, or glycerine of carbolic acid (half an ounce to eight ounces). In cases of syphilitic sore-throat, a gargle of perchloride of mercury (three grains to eight ounces) has been recommended. In many cases combinations of different kinds of gargles are beneficial. Water, barley-water, rose or orange-flower water sweetened with a little honey, glycerine, or syrup, constitute the bases of most gargles. JOHN C. THOROWGOOD.

GASTEIN, in the Austrian Alps. Simple thermal waters. *See* MINERAL WATERS.

GASTRALGIA (γαστήρ, the stomach; and ἄλγος, pain).—SYNON.: Gastrodynia; Fr. *Gastralgie*; Ger. *Gastralgie*; *Magenschmerz.*

DEFINITION.—Pain in the stomach, which occurs in various disorders of that organ and related parts.

SYMPTOMS.—In acute erythematous gastritis a burning painful sensation affecting the stomach, and not infrequently extending up the œsophagus, is felt almost immediately after taking food or a stimulant liquid. In acute catarrhal gastritis pain is seldom complained of. In ordinary chronic gastritis it is usually absent; or, at most, only a slight heaviness or fulness after food forms a symptom of the malady. In what the writer has named 'eczema of the stomach' the pain is very severe, comes on two or three hours after food, and is temporarily relieved by eating. The same kind of pain may be observed whenever there is profuse mucous secretion, but it is less severe than in cases where gastric disturbance replaces eruptions of the skin. The pain accompanying pyrosis is of a spasmodic character, and is relieved by the ejection of a tasteless fluid. Severe pain is a common accompaniment of atonic dyspepsia occurring in nervous or hysterical persons. It comes on when the stomach is empty, but is often aggravated directly after food, and is relieved by the escape of flatus, and by stimulants. The most severe gastralgia is that accompanying ulceration of the stomach. In this disorder it is referred to one spot, and is likewise often felt in the back. The mere fact that a pain in the epigastric region is confined to one small spot should induce the practitioner to view the case with suspicion. The pain in ulceration is usually absent when the stomach is empty, but comes on from two to ten minutes after food. In other instances a longer period, such as half an hour, elapses; but it is this definite relation to the digestive process that makes the pain of ulceration characteristic of the disease. It is usually said that when the pain comes on directly after food the cardiac region is the seat of the ulcer; and where a longer interval takes place the sore will be found near the pylorus. This, if true as a general rule, is, nevertheless, open to many exceptions; for, as a patient observed, the pain occurred later after taking food in proportion as she improved in health, and the first evidence of a relapse was the shortness of the interval of ease after eating. In cancer the pain is more continuous than in simple ulcer; it is less influenced by the digestive process, and is more diffused. It is, however, no uncommon circumstance to find cancer of the stomach without any complaint of pain. The softer kinds of malignant growth seem to the writer least apt to cause suffering, probably because the peritoneum is less liable in such cases, than in the other forms, to be affected with inflammatory action.

Neuralgia of the stomach is a favourite disease with some authors. There is no doubt that the normal sensibility of the stomach is vastly exaggerated under some conditions, but the writer's observation leads him to believe that neuralgic pain affecting the stomach *independently of other disease*, is a much rarer complaint than is generally supposed (*see* STOMACH, Diseases of). The writer has met with three different forms of pain in the region of the stomach ascribed to neuralgia, which are evidently of a different nature: (1) Where severe pain has come on at some period of the day at a certain hour, at a considerable period after the commencement of digestion. In many of these cases it has been evident on inquiry that the apparent periodicity was the result of the punctual disposal of the chief meal of the day. They were, in fact, cases of chronic catarrhal gastritis attended with considerable secretion; most of them occurred in gouty men, and might be classed under the head of eczema, rather than of neuralgia of the stomach. (2) Cases such as the following: A young lady had suffered for many months from agonising pain in the left hypochondrium, coming on at each menstrual period, and resisting all methods of treatment. In this and other similar cases, it will be found that the seat of the pain is really external, in the intercostal nerve, and not in the stomach itself. (3) Severe attacks of pain in the left hypochondrium and epigastrium in females of a nervous temperament, who had either been born, or had passed most of their lives, in tropical countries. The real seat of the pain in such cases appears to be the colon; there is always constipation; and a mild aperient and tonic treatment is usually effectual in removing or ameliorating the complaint.

S. Fenwick.

GASTRIC FEVER (γαστήρ, the stomach).—A popular name for a febrile condition attended with prominent gastric symptoms; as well as for typhoid fever. *See* Typhoid Fever.

GASTRIC GLANDS, Diseases of (γαστήρ, the stomach).—*See* Stomach, Diseases of.

GASTRIC ULCER (γαστήρ, the stomach).—*See* Stomach, Diseases of.

GASTRITIS (γαστήρ, the stomach).—Inflammation of the stomach. *See* Stomach, Diseases of.

GASTRODYNIA (γαστήρ, the stomach; and ὀδύνη, pain).—A painful affection of the stomach, generally considered as of a neuralgic nature. *See* Gastralgia.

GASTRO-ENTERIC (γαστήρ, the stomach; and ἔντερον, the intestine).—This term is applied to those morbid states in which the stomach and intestine are simultaneously affected. The continuity and similarity in structure of these viscera render them peculiarly liable to coincident disease; and this is more particularly noticed in affections of an inflammatory type (gastro-enteritis), or of a degenerative nature. At the same time, as gastritis may occur and run its course without giving any indication that the intestine is involved, so enteritis may be developed with little or no disorder of the stomach. The same causes appear to determine similar diseases in the stomach and in the intestine; but why at one time both should suffer, and at another time one should escape, is not known. Occasionally it would seem that the entire alimentary canal beyond the œsophagus is attacked at once, and the gastro-intestinal catarrh of children is an example of this. Sometimes the disorder commences in one part of the canal, and spreads until both the stomach and the intestine are involved. *See* Intestines, Diseases of; and Stomach, Diseases of.

W. H. Allchin.

GASTRORRHŒA (γαστήρ, the stomach; and ῥέω, I flow).—An excessive flow of mucus from the lining membrane of the stomach, due to catarrh. *See* Stomach, Diseases of.

GELATINIFORM CANCER.—A synonym for colloid cancer. *See* Cancer.

GENERAL.—This word, as employed in relation to medicine, has several applications. Thus we speak of a *general disease*, which is a disease affecting the whole system, as distinguished from a local affection. As further examples may be mentioned *general debility*, *general paralysis*, and *general dropsy*. So, with respect to therapeutics, *general treatment* refers to remedial measures intended to affect the organism as a whole. In connexion with the sciences of therapeutics, pathology, &c., the word *general* is intended to denote the essential principles of these sciences, as distinguished from their special divisions.

GENERAL PARALYSIS OF THE INSANE.—Synon.: General Paresis; *Dementia paralytica*; Fr. *Paralysie génèrale incomplète*; *Périencéphalite chronique diffuse*; Ger. *Allgemeine progressive Gehirnlähmung*; *Paralytischer Blödsinn.*

Definition.—A gradual loss of the power of co-ordinated movement, accompanied by gradually increasing mental disturbance and decay.

Ætiology.—The subjects of general paralysis are most frequently of the male sex, and between 30 and 50 years of age. It may be brought on by excessive mental labour, by severe anxiety, by alcoholic or venereal excess, or by any prolonged strain upon the mental organisation. It may also be induced by a blow or other direct injury to the head. Hereditary predisposition is probably not without influence upon its production, but this is not so frequently present as in most other forms of insanity. The disease most frequently attacks persons who have previously been apparently in the enjoyment of vigorous health.

Anatomical Characters.—General paralysis is characterised by atrophic and degenerative changes of the cerebrum chiefly affecting the convolutions of the vertex, of the anterior and middle lobes, and round the olfactory bulbs at the base. These changes involve destruction of the nerve-cells of the outer layers of the cortex, and augmentation of the lymph-connective system. There is also thickening of the membranes, adhesion of the pia to the surface of the convolutions, thickening of the coats of the blood-vessels, enlargement and sacculation of the perivascular canals, and engorgement with disintegrated material. In advanced cases the degenerative changes affect every part of the nervous system.

Symptoms.—*Physical.*—The physical symptoms of general paralysis of the insane are first apparent in the muscles of articulation and expression. There is an occasional thickness of utterance, perhaps observable only in the pronunciation of the more complex sounds, and a peculiar convulsive tremor of the upper lip accompanying the least excitement. A similar fibrillar trembling may also be observed in the tongue, when an attempt is made to hold it out. A loss of freedom of stroke in the handwriting is manifested at an early stage. This loss of muscular control gradually spreads over the whole system, its onward course being, however, not infrequently interrupted by very remarkable though generally brief remissions. Before the patient is laid completely prostrate, the affection both of articulation and of gait strongly resembles the failure of co-ordinate movement produced by drunkenness. In the last stage the patient lies quite helpless; the power of articulation and every kind of voluntary movement are lost; there is also a strong tendency to the formation of bed-sores; and spots of ecchymosis are apt to appear on the application of even gentle pressure. Inequality of the pupils is usual from the commencement of the illness; but they do not often remain long in one condition, sometimes one pupil and sometimes the other being dilated or contracted. A characteristic feature of the disease is the occurrence of congestive or epileptiform attacks, but they are very variable, both in their frequency and in the stage at which they are first observed.

Mental.—The mental symptoms generally precede the physical, though some cases occur in which the condition of the mind is not such as to attract attention till some time after the motor symptoms have become obvious. Sleeplessness and general restlessness are usually the first indications of the derangement, and with these may be associated transient states of depression and hypochondriacal fancies. Enfeeblement, shown by forgetfulness and incapacity for continuous thought, is generally an early symptom; and in some cases a gradual increase of this enfeeblement, till absolute fatuity is reached, constitutes the prominent mental symptom. A common condition from the commencement is an inordinate disposition to embark in any, even the most impracticable, undertaking that may be suggested. There is always observed a peculiar facility of disposition, generally good-humoured, but liable to be interrupted by fits of passionate excitement. Frequently there is a very remarkable extravagance, both in thought and act. In most cases acute maniacal attacks take place, in which the excitement presents a specially extravagant character. The semblance of probability and coherence found in ordinary acute mania is generally absent. The prevailing ideas are of grandeur, colossal size, infinite number, power, wealth, and rank, all heaped together in wild confusion. Every such maniacal attack marks an appreciable step in the progress of mental decay; and the tendency is always more or less steadily to complete fatuity. In some comparatively rare cases, especially where there is a tendency to phthisis, the mental condition is mainly one of depression. Remarkable remissions of all the symptoms are sometimes met with.

Diagnosis. — The diseases from which general paralysis of the insane requires to be distinguished are paralysis due to cerebral hæmorrhage, embolism, encephalitis, or tumour of the brain; hysterical and toxic paralysis; syphilitic disease of the brain; locomotor ataxy; alcoholic insanity; senile dementia; and muscular atrophy. The diagnosis is generally easy, if attention be paid to the presence or absence of the convulsive tremors in the muscles of articulation at the commencement; the general and progressive course of the loss of co-ordination; and the peculiar mental facility and extravagance.

Prognosis.—Complete recovery seldom, if ever, takes place in general paralysis of the insane. The ordinary duration of the disease is from a few months to three or four years, though cases of ten years' duration occasionally occur.

Treatment.—In ordinary circumstances the treatment cannot be properly carried out in a private house; removal to an asylum will therefore generally be necessary. Little benefit is to be derived from drugs. The diet ought to be nutritious, but non-stimulating. The food ought to be minced or pulpy, and care should be taken to prevent an accumulation of it in the pharynx, as fatal choking is sometimes produced in that way. If this should be threatened, the tongue should be immediately pulled forward, and the bolus extracted with the finger. On account of the liability to bed-sores, the patient should as long as possible be prevented from lying constantly in bed. John Sibbald.

GERMS OF DISEASE.—This is a phrase in common use, the acceptation of which is various, and often more or less vague. So far as it refers to actual things or objects, they also are probably diverse in nature, though at present our knowledge of many of them is based rather upon conjecture than actual experience.

As a phrase, 'germs of disease' is most commonly used in the following modes:—

(*a*) A person may be said to inherit the germs of disease when there is reason to believe that the constitutional, general, or local disease from which he is suffering is of a kind which has been common in the family or stock whence he has descended, and when the disease is one which seems prone to manifest itself in this way. It may, in this sense, be said that a person inherits the germs of gout, scrofula, tuberculosis, cancer, or syphilis; and, in either of such cases (with the possible exception of the two latter), no one would, on reflection, be able to find that he meant anything else than that the patient had inherited a certain general disposition, habit, or bodily tendency, in which, under the influence of slight exciting causes, one of these morbid conditions should be prone to manifest itself.

(*b*) In a still looser sense, the phrase is sometimes used to signify the mere commencement or initial stage of a certain disease, as when it is said that the germs of a phthisical patient's malady date from a certain catarrhal attack, or that a patient now suffering from a severe brain-affection contracted the germs of his disease in India or elsewhere on the occasion of some slight sunstroke. Here the expression would be used in a purely metaphorical sense.

(*c*) The phrase is most commonly employed, however, in reference to the real or supposed causes of communicable morbid processes or diseases, either local or general—those which spread either from part to part in the same person, or from person to person in the same community.

In the spread from part to part, as during the 'generalisation' of some malignant new-growth, the agency of 'germs of disease' is, perhaps, not infrequently more imaginary than real. Results are apt to be ascribed to 'infection' where nothing of the kind has been in operation—as when similar perverted tissue-changes may chance to manifest themselves, either simultaneously or consecutively, in different parts of the body, as results of some single or similar underlying cause or tendency.

In the spread from person to person of local or general contagious affections, the same possible source of fallacy has to be borne in mind. We must be upon our guard against ascribing too general an influence to 'germs of disease.' In certain cases these may have been in the first place non-existent, as when such a disease has been 'autogenetic,' and in no sense a derivative of antecedent disease of the same kind. This caution is especially applicable in regard to such an affection as erysipelas—which, although certainly contagious, is also on very good grounds judged to be 'generable,' especially during certain states of lowered health induced by renal disease and some other visceral affections. If it is not so certainly established, it is by many deemed probable, that a similar caution may be necessary in regard to some more general contagious affections, such as diphtheria, typhoid, typhus, and relapsing fever, and cholera, which, though certainly contagious, may also be autogenetic. On this subject, however, much doubt and uncertainty still prevail.

The consideration of this third use of the phrase 'germs of disease' conducts us naturally to the question as to the nature of the things or objects which may be included under the same name, and this again to the modes in which they operate. But as these are questions which are discussed under CONTAGION, further reference to them here is unnecessary. *See* also MICRO-ORGANISMS.

H. CHARLTON BASTIAN.

GERONTOXON (γέρων, an old man; and τόξον, a bow).—A synonym for arcus senilis. *See* ARCUS SENILIS.

GEYSERS, The, in Sonoma County, California, U.S.A.—Hot springs, with alum, iron, and sulphur. *See* MINERAL WATERS.

GEYSERS, The, in Wyoming Territory, U.S.A.—Thermal waters. *See* MINERAL WATERS.

GIDDINESS (Sax. *gidig*, turning round).—A synonym for vertigo. *See* VERTIGO.

GIESSHÜBEL, in Bohemia.—Acidulous alkaline table water. *See* MINERAL WATERS.

GINGIVITIS (*gingivæ*, the gums). Inflammation of the gums. *See* MOUTH, Diseases of.

GLANDERS (*glans*, an acorn).—SYNON.: *Equinia*; Fr. *Morve*; Ger. *Rotz*. Its associated condition is named Farcy; Fr. *Farcin*; Ger. *Wurm*; *Hautwurm*.

DEFINITION.—A contagious febrile disease, associated with the presence of a specific microbe—the *bacillus mallei*; communicated to man from the horse, ass, or mule; characterised by inflammatory lesions of the nasal and respiratory mucous membranes, and of the lymphatic vessels and glands, with general pyrexia, pains in the joints and muscles, and great prostration, and usually accompanied by a pustular cutaneous eruption.

The local manifestations vary in order of appearance, and in comparative severity in different cases. In those in which the nasal and respiratory mucous membranes are earliest or most severely affected, the disease is customarily called 'glanders;' while to those in which the lymphatic system first and especially suffers, the designation 'farcy' is applied. But no sufficient reason exists for considering glanders and farcy as distinct diseases. They are commonly associated; and whichever set of symptoms may appear first, the other, as a rule, sooner or later follows. Further, it has been proved that the same virus may give rise to either set of symptoms, or to both. And it would seem that the order of appearance is determined in great measure by the mode of communication of the virus, as well as to some extent perhaps by the condition and constitution of the recipient.

Glanders in man is a very rare disease; and it is only within the last sixty or seventy years that its occurrence has been clearly recognised, and its history made out. When it does occur, it proves fatal in a very large proportion of cases. Taking the acute and chronic cases together, 208 out of 245 are recorded as having terminated fatally. Nevertheless, out of 2,026,296 deaths in England and Wales during the four years 1871–1874 no more than 19 were registered as due to glanders, and during the four years 1885–1888 only 18 out of 2,101,755 deaths. The slight decrease in the proportion during the later period is worthy of note as due in measure probably to the more stringent precautions observed. During the year 1889, however, there were recorded 8 fatal cases of glanders out of 518,353 deaths.

Ætiology.—There is no evidence to suggest that glanders ever originates in man, whatever may be the case with regard to the lower animals. It is always communicated; and almost always by direct inoculation of virus from a diseased animal. Horses, asses, mules, some carnivorous animals, as lions, tigers, &c., are liable to take the disease; and, among the smaller animals, guinea-pigs, hedgehogs, field-mice, and wood-mice. Oxen seem to enjoy immunity even when experimentally inoculated, as also rats, white mice, &c.; and pigs, dogs, sheep, and rabbits are only slightly susceptible. In some few instances the disease has been communicated from man to man. It is scarcely ever met with except in those who are more or less constantly employed among horses, and who are therefore liable from time to time to come in contact with diseased animals, or the morbid discharges from them. The mode of communication can in most cases be easily traced; and generally the virus is derived from the secretion of the nasal mucous membrane of the diseased animal. The rarity of the disease in man, considered in conjunction with its comparative frequency and the rapidity with which it spreads among horses, would seem to indicate that the virus is more or less fixed, and not readily diffusible through the air, and that man is not very susceptible to its influence.

In most cases the history renders it clear that the virus has been received through some cut or abrasion of the skin or mucous membrane. In some few instances it appears probable that the virus may have been absorbed through the unbroken mucous membrane or skin. The recent sad case resulting in the death of Dr. von Hofman, of Vienna, who was engaged in experimental investigations into the propagation of glanders, seems to show conclusively that absorption may take place through the mucous membrane of the respiratory tract from inhalation of the virus; and the observations of Dr. Babès, in Roumania (where glanders appears to be more common than in this country), go to prove that without solution of continuity of skin the glanders bacilli may penetrate by following the hair-follicles, in which they multiply and, proceeding thence, may infect the system.

Symptoms and Course.—However the virus may have been communicated, a period of incubation varying from three to eight days, and in some rare instances prolonged even to three weeks or more, ensues before the symptoms of constitutional infection become manifest. The longer the period of incubation, the less acute, as a rule, is the course of the disease. The duration of the disease, as well as the order of development of the local affections, varies greatly in different cases. Hence the classification, on the one hand, into cases of *acute*, *subacute*, and *chronic glanders*; and, on the other, into cases of *acute* and *chronic glanders*, and *acute* and *chronic farcy*. But nothing like clear lines of distinction can be drawn between any of these classes.

The earliest constitutional symptoms are a sense of general discomfort, fatigue, prostration, and chilliness, with headache, and obscure pains in the muscles and joints. As the disease advances, these pains become more severe, and simulate those of rheumatism. Pyrexia, at first but slight, rapidly becomes established. The pulse is quickened and sometimes full, the skin hot and dry, the tongue foul, the urine scanty and high-coloured; and the patient suffers much from restlessness, sleeplessness, and loss of appetite, often with obstinate constipation. Sometimes the feverishness is intermittent, but more frequently continued, or intermittent at very irregular intervals. Still later, rigors occur—more severe than such as may have occurred at an earlier period, followed by profuse sour perspirations and clamminess of skin; the pulse becomes very rapid, weak, and compressible; diarrhœa, with very fœtid stools, succeeds the constipation; the thirst is excessive; respiration becomes more and more difficult and laboured; low delirium, with tremors, is followed by coma; and death ensues from exhaustion. In the acute form, the disease runs its course in an average period of about sixteen days; some cases have terminated fatally within a week; others have been prolonged for four weeks. In the less acute form the duration may be from six weeks to two months. And in the most chronic form, in which all the symptoms are less severe, the duration may extend over several months, and in some cases recovery ultimately takes place.

Local manifestations.—In association with the constitutional symptoms thus indicated, the following local manifestations present themselves, but, as already stated, somewhat differently in different cases.

The wound or abrasion through which the virus has been introduced, or the spot at which it has been applied (for the wound may have healed), becomes inflamed, tense, painful, and surrounded by spreading erysipelatous redness. The ulcer which appears enlarges, assumes an unhealthy, corroded, chancroid aspect, and discharges dirty sanious and often offensive matters.

The lymphatic vessels of the part become inflamed, and present a knotted, cord-like, and subsequently irregularly nodulated condition—the *farcy-buds* in the human subject. The glands are infiltrated and enlarged, and the whole part is swollen and œdematous. The lymphatic glands and vessels of other parts subsequently become affected, but not perhaps to the same extent as in the horse. Resolution and absorption to a greater or less extent sometimes take place; but much more frequently suppuration of low type, abscess-formation, and the production of foul, ulcerating cavities, with hard irregular edges, and fistulæ follow.

At a variable period in the course of the disease—from within forty-eight hours to the end of three or four weeks—an eruption, regarded as characteristic, appears on the skin, especially on the face, chest, and abdomen. This first shows itself as irregularly scattered collections of red spots, 'which are very small and resemble fleabites, but soon acquire a papular elevation, subsequently rising above the level of the surface, like small shot, and assuming a yellowish colour. They lie each in a kind of hole in the corium, as if the latter had been punched out' (Virchow). They appear to be due to the deposit of some neoplastic material, which subsequently softens and breaks down. By-and-by they become vesicular (some say from the first they are vesicular), and then rapidly sero-purulent, with inflamed livid bases. The surrounding skin is red, swollen, and erysipelatous-like. When close together, these pustules become confluent, and give rise to irregular ulcerated surfaces, with soft, brownish, sloughy coating. Large collections of similar deposit in the subcutaneous tissue give rise to hard, painful, boil-like formations, which, breaking down, lead to extensive sloughing of the skin and deeper structures, with thick, dirty white or sanguineous offensive discharge.

The mucous membranes—and first and especially that of the nose—are sooner or later affected by specific inflammation and ulceration. Whether the inflammatory process as a secondary affection more often begins in them or in the skin is not clearly made out. But in some cases in man, as commonly in the horse, the disease is probably communicated by application of virus to the mucous membrane of the nose or other part of the respiratory passages, which thus becomes primarily affected.

When the nose is affected (as is always the case primarily or secondarily in the form of the disease especially called glanders), there is first a discharge of comparatively thin, colourless, 'catarrhal' mucus. This soon becomes thicker and coloured; and there is considerable pain, heat, redness, and œdematous swelling about the nose itself and the adjacent parts of the face. Ultimately the discharge becomes thick, sticky, tenacious, and semi-purulent, of a dirty yellowish or brownish colour, and often stained with blood. In all cases probably there is ulceration of the mucous membrane, following tubercle-like deposits in it; and the ulceration sometimes extends so deeply as to lead to perforation of the septum, or partial destruction of the turbinated or palate bones. The ulceration often occurs only in the upper part of the nose; and the mucous membrane of the frontal and other sinuses is liable to be similarly affected.

When the lymphatic and cutaneous systems suffer first and especially, the nasal mucous membrane is not affected until towards the termination of the case; and in some instances death has occurred before this affection of the nose has taken place.

Bronchial catarrh, with rhonchi heard all over the chest, accompanied by severe cough with profuse expectoration, indicates the implication of other parts of the respiratory mucous membrane. The conjunctiva and the mucous membrane of the mouth, gums, fauces, and especially the tonsils, are often affected to a serious extent; so also is the larynx; hoarseness, pain, and difficulty in speaking resulting therefrom.

ANATOMICAL CHARACTERS. — The pathological lesions found on *post-mortem* examination are such as might be anticipated from the signs and symptoms manifested during life. To these, however, may be added fluidity of the blood; softness and rottenness of the muscles, with hæmorrhagic abscesses in them (considered by Billroth as characteristic); patches of grey hepatisation in the lungs, or lobular pneumonia; abscesses in the parotid, submaxillary, and cervical glands; and nodules hard or softening down in the liver, spleen, and membranes of the brain.

The characteristically associated bacilli may be found in the nodules (especially in such as are comparatively recent), in the mucous membranes, skin, liver, spleen, &c. They have also been found in the blood and various morbid secretions; but in these they are often very difficult to discover. Flügge describes them as 'thin rods, similar to the tubercle-bacilli, but more uniform in size, and somewhat broader; like these, they are often slightly curved.' This description of Flügge's has been adversely criticised by Fränkel and others, who have worked with the bacilli of glanders. They are much more readily stained than are tubercle-bacilli; are shorter and much thicker; and they often present a single unstained spot midway between the ends, quite unlike tubercle-bacilli. The specimens are best prepared by staining with alkaline methylene blue, and subsequent careful treatment by very dilute acetic acid. When inoculated upon sterilised potato from a farcy bud, they present a characteristic tuberculated chocolate-coloured growth in forty-eight to seventy-two hours, if kept at the temperature of the blood.

Diagnosis.—The diagnosis of glanders in man may be difficult in the early stage, particularly if the history be defective and no external wound appear. But when the disease is fully developed, the signs and symptoms, especially if taken in conjunction with the occupation and history of the sufferer, are sufficiently characteristic. In some rare instances, however, in which the constitutional symptoms have been slight, and the local manifestations have very slowly developed themselves, great difficulty has arisen, and the true nature of the disease has not even been recognised until after death. Rheumatism, typhoid fever, and pyæmia, and, in regard to the more chronic cases, syphilis and tuberculosis, are the diseases with which it is said that glanders may possibly be confounded. The presence of the characteristic bacilli, if discovered, may be regarded as pathognomonic and conclusive; and in doubtful cases, at any rate, they should always be sought for in the morbid secretions and discharges.[1]

Prognosis. — The prognosis in glanders must be extremely unfavourable. Two or three cases only are on record in which recovery has taken place from the more acute form of the disease.[2] In the more chronic forms, however, the deaths have been only about fifty per cent. The more slowly and less severely the symptoms develop themselves, and the longer the patient survives, the better is the chance of ultimate recovery.

Treatment.—The constitutional treatment should be supporting, stimulating, and soothing, and varied from time to time according to the indications afforded. Quinine in large doses, and perchloride of iron with or without perchloride of mercury, may be useful. But at present, although very many drugs have been tried, none has been found having any marked specific effect on the course of the disease, unless indeed exception be made in favour of mercury. Gold reports a case successfully treated by prolonged mercurial inunction. Locally any suspicious wound should be freely cauterised or excised as soon as attention is directed to it. All abscesses and collections of morbid material should, as far as possible, be freely incised, and their contents thoroughly evacuated. The resulting cavities and fistulæ should be frequently and thoroughly washed out with germicide and disinfectant solutions—perchloride of mercury, chloride of zinc, sulphate of copper, or carbolic acid in safe dilution; and antiseptic dressings, covered or not according to circumstances by poultices, should be applied. The operator and those who dress the wounds should wear indiarubber gloves. Inhalations of iodine, or carbolic acid vapours or sprays, should be frequently used, and the nasal passages and cavities should be thoroughly syringed from time to time with disinfectant solutions, as dilute carbolic acid, iodised water, or Condy's solution.

Arthur E. Durham.

GLANDULAR DISEASES.—A general denomination for diseases of glands of all kinds. *See* Bronchial Glands, Diseases of; Lymphatic System, Diseases of; and Mesenteric Glands, Diseases of; also the several special glands.

GLAUCOMA (*γλαυκός*, sea-green).—In its modern acceptation, this word is used to include all the conditions, whether acute or chronic, primary or secondary, which are produced by heightened tension or increased fluid-pressure within the eyeball. The word was originally applied only to those cases of heightened tension in which there is a greenish opaque appearance behind the pupil. *See* Eye, and its Appendages, Diseases of.

GLEET.—Synon.: Fr. *Goutte militaire*; Ger. *Nachtripper.*

Definition.—An urethral discharge, milky, viscid, scant in quantity, appearing as a drop at the meatus urinarius or as shreds floating in the urine, composed of leucocytes, epithelium cells of various forms, and crystals of phosphates and urates.

---

[1] In Eastern Prussia, where glanders is very frequent, an extract (*mallein*) of the *bacillus mallei* (obtained with glycerine at 95° F., from pure growths of the bacillus upon potato) has been employed in the diagnosis of doubtful cases of glanders or farcy in the horse. The extract is filtered free of bacilli, and concentrated; about four minims of this are injected under the skin of the suspected horse. If latent glanders be present, rise of temperature of more than 3° is said to follow within the next eight hours. If the animal be free from glanders or farcy, the temperature is said to rise, if at all, less than 2°. Favourable reports are already given of this method of diagnosis both in Germany and at the Institut Pasteur in Paris. Unfortunately the preparation of the extract is not devoid of danger. The manipulations have proved fatal to two investigators: one of them Dr. Kalning of Dorpat, the original discoverer of *mallein.*

[2] Professor Karl Fränkel, of Königsberg, accidentally inoculated himself in the spring of 1891, and recovered, though after several months' illness.

Ætiology and Symptoms.—In most cases of gleet, though some chronic urethral discharges arise from masturbation and excessive venery, a clap has preceded the discharge by some months or years. In such cases the discharge may escape notice for a time without really disappearing altogether, and again become plentiful without obvious cause. Pain is either absent, or a slight tickling or smarting at the parts inflamed is felt during micturition or at other times. But these symptoms vary so greatly in different patients, that much reliance cannot be placed on them for indicating the seat of the inflammation. Nevertheless, when pain is described to be felt in the loins, thighs, or anus, the prostatic portion is generally affected. If the urine is voided in three portions, and the first portion is stocked with floating shreds, while the second and third portions are clear, the discharge is probably formed in front of the prostate. If there be a clear second portion, and a few shreds appear in the third portion, that being also fairly clear, some of the discharge is prostatic. If the third portion is turbid the uvula of the bladder is inflamed.

Physical signs.—When seeking for the cause and locality of a gleet, it is well to divide the examination of the urethra into two parts; the pendulous and bulbous portions being examined first, the membranous and prostatic portions secondly. The precise situations of the lesions in the penile portion are ascertained by passing along the urethra a bullet-sound or bougie (No. 25 or 26 of the French scale), or Otis's urethrameter, if the meatus be too small to admit a bullet large enough to expand the passage to its full extent. As the bullet reaches an inflamed spot a slight resistance is noted, and the patient feels pain when the instrument passes over the inflamed or rigid area. Both resistance and pain cease when the area is left behind. Should the inflammation have existed long enough to produce fibrous bands, the onward passage of the bullet-sound is impeded, or arrested if the bands be too short to permit the bullet to slip past. A smaller bullet must be taken, or the urethrameter's bulb must be contracted until the obstruction can be passed. By this means the amount to which the normal capacity of the urethra has been lessened is learned. The bullet-bougie is not usually passed farther than the bulb, though it may be pushed to the bladder by a little manœuvring. A tolerably accurate diagnosis can thus be made, though it is always advantageous, and sometimes indispensable, to complete the examination by ocular inspection. This is done by the endoscope; and, by its means, the condition of the obstructing patches may be more precisely ascertained, and, as well, the absence or presence of inflammation of the glands of Littré and lacunæ Morgagni, or of the numerous ducts which open into the membranous portions of the canal. *See* Endoscopy.

The conditions causing gleet are: (1) Chronic inflammation of areas of the mucous membrane; (2) Granular patches; (3) Warts; (4) Ulcers; (5) Inflammation of glands and sinuses; (6) Chronic catarrh of the mucous surface and ducts of the prostate; (7) Chronic prostatitis.

1. **Chronic inflammation of the mucous membrane.**—In this, the most common form of gleet, the interior of the urethra, naturally rosy-pink when not inflamed, is dull red or purplish-red in patches or streaks. It must not be forgotten that the mucous membrane of the urethra, especially of the penile portion, after several attacks of inflammation, may assume a greyish or slatish red hue, or a brownish stain from absorbed pigment, when the colouring matter of the blood has escaped into the tissues. Here and there viscid grey flocculi of muco-pus adhere to the inflamed surfaces. The red areas are less elastic than the unaffected parts, and in course of time may develop into bands of stricture-tissue, which more or less diminish the expansile power of the urethra. Common positions for these inflamed areas are the pars cavernosa at two or three inches from the meatus, or at four or six inches from it—*i.e.* in the bulbous portion of the urethra. But the membranous and prostatic portions are also the seats of chronic inflammation in gleet. In long-standing cases white unyielding areas are disposed among the patches of inflammation. They are fibrous toughenings of the tissues. These may remain or disappear. When they are left, some obstruction is caused to the expansion of the urethra—that is, more or less stricture. Usually several months are needed for the patches of inflammation to develop into fibrous bands.

2. **Granular patches.**—These are excessively common in any part of the penile and bulbous portions of the urethra, while they are not rare in the membranous and prostatic portions. They develop on the areas of chronic inflammation, especially if these patches have been excoriated or ulcerated; and it is rare not to find them in a case of six months' duration on the third and fourth inches from the meatus. The bullet-bougie reveals their presence by a slight resistance to the passage of the sound, and by a smarting pain felt while the bullet passes over them. When the sound is withdrawn, it is often marked with a little bloody muco-pus. If the endoscope is then inserted, the granular patches appear as bright carmine-red areas of uneven or velvety aspect, readily bleeding if the instrument be roughly pushed over them. Here and there they are flecked with little dots of greyish mucus, which is very adherent, and which protects the granulation

from the action of astringents. In course of time the granulations may heal into white fibrous scars, or may subside and leave the membrane pale and smooth, but supple as before. Their duration is very long and uncertain, and their cure is tedious.

3. **Warts.**—Warts, which are most commonly situate just within the meatus, may stud the whole length of the urethra. Near the meatus they are arboriform; lower down, sessile, or only slightly pedunculated. Identical in structure with the warts on the glans or in the furrow of the penis, they are ordinary papillomata. They are also frequent in the membranous and prostatic portions. Sometimes a single sessile wart in this position will be the sole cause of a gleet which is troublesome to the patient through its obstinacy, otherwise most harmless.

4. **Ulcers.**—Ulcers are not uncommon in the early stages of chronic urethritis. They appear at any part of the canal, and are indicated by smarting felt at a particular point of the passage during micturition, or when the bullet-sound passes over them. But they can be diagnosed only with certainty by the endoscope. When seen, they appear as minute, round, shallow excoriations, with sharply defined edges and yellow floor. If left untreated, these shallow erosions may heal and contract into thin and somewhat prominent layers of scar-tissue, disposed sometimes longitudinally, more often obliquely or transversely across the urethra. When fully matured they constitute the 'bridle stricture.'

In persons who have tough, well-formed scars of stricture-tissue, ulceration of some parts of this scar-tissue is not uncommon. These ulcers form again and again, and are best treated by thorough dilatation of the strictures, and washing with mild astringent injections.

5. **Follicular sinuses.**—These sinuses, inflamed during acute gonorrhœa, often secrete discharges long after the gonorrhœa has ended. In the anterior urethra generally only a few such crypts are chronically inflamed, but in the prostatic portion several crypts secrete a thin turbid fluid. This form of discharge may be considered to be caused by chronic prostatitis, and it will be described farther on. In cases of hypospadias, at the extreme end of the urethra, close to the margin of the meatus in the glans penis, there is in many persons on each side of the orifice a crypt three-quarters of an inch long. These crypts often continue to discharge pus long after the gonorrhœa has subsided elsewhere. Other sinuses, but shorter ones, open into the interior of the normal urethra. These follicular sinuses do not form indurated patches in the substance of the urethra; hence they never cause stricture. Temporary narrowing may, however, result from the distension of an inflamed and suppurating sub-mucous follicle, which before the evacuation of its contents may project on the wall of the urethra. The discharge from such a cavity is much more copious than from a simple follicle, and is very slow to dry up, though this end is usually reached if there be no stricture in front of the suppurating follicle to impede the easy flow of the urine past the follicle. Usually the bulbous and membranous parts of the urethra are the slowest to recover.

6. **Chronic catarrh.**—In chronic catarrh of the prostatic urethra, with a history of preceding gonorrhœa, there may be a scanty milky-white discharge seen at the meatus when several hours have elapsed after micturition, or the orifice may be sealed by the dry discharge, or there may be only shreds or flocculi in the urine. In addition to the slight discharge, the patient may complain of occasional great increase of it after hard riding, or dancing, or free indulgence in wine, but this does not always happen. The shreds consist mainly of pus-cells held together by mucus; there are also present epithelial cells of pavement and transitional forms, granular cells, crystals of urates, &c. They have no characteristic value, as similarly formed shreds are washed from granular patches placed in the anterior urethra. Fine filamentous shreds are formed in the folds of the mucous membrane while the urethra is at rest. They are also formed as casts of the prostatic ducts when inflammation has extended into the body of the prostate. These casts are generally built up more of epithelial and granular cells, and less of pus-cells, than those formed in the urethra. The prostatic origin of these shreds is shown by the fact that urine drawn through a catheter from the bladder is bright, clear, and free of shreds. When the mucous membrane of the prostate is only, or mainly, affected, the symptoms of disease are very indefinite, and are often limited to the scanty viscid discharge. Hence no diagnosis can be positive without an examination of the urethra throughout its length.

To examine the urethra with a sound, a No. 25 or 26 of the French scale should be used. If a sound of this calibre will not enter the meatus, it is better to cocaine the mucous membrane within the meatus and nick the orifice at once to a sufficient size; for while the meatus is contracted, the cure of prostatic gleet is almost hopeless. The sound is then passed slowly and gently along the urethra. No pain is felt until the prostate is reached, when a hot or scalding pain is felt, which ceases directly the instrument is withdrawn. The pain is the same whether a curved sound or flexible bougie be used. When the prostate is swollen there is more resistance, but the pain is less scalding to the patient.

If the urethra between the triangular ligament and the orifice into the bladder be inspected, several changes from healthy conditions may be found. The mucous membrane in health is pale pink, or bluish pink in colour, faintly marked with longitudinal carmine lines, which of course seem to radiate from the centre of the lumen, owing to the funnel-shaped contraction of that part of the urethra which is exposed to view by the endoscope.

When there is chronic inflammation, and the surface has not become indurated, it is of deep carmine hue, closely beset with small eminences which give it a strawberry-like appearance, a resemblance often enhanced by the minute flocculi of pus which adhere to the surface among the prominent granulations, and simulate the yellowish seeds of the ripe strawberry. These vascular excrescences are at first general over the mucous membrane; but, as time goes on, they subside, and are represented by a few papillary tufts or excoriations, which become permanent if not treated. The congested surface bleeds readily, so it must be well mopped, using tincture of hamamelis, if the bleeding is obstinate, before inspecting it or applying other astringents to the surface. Most commonly, in chronic catarrh of the urethra there are excoriations, sometimes granulations, and, rarely, pedunculated warts. If the inflammation has lasted several months, the verumontanum is often shrunken and white, and the orifices of the ejaculatory ducts are invisible or show as dark greyish dots.

7. **Chronic prostatitis.**—If there be general congestion of the organ, and not merely superficial catarrh, the symptoms are more pronounced. In such cases there is usually some pain, which is variously described. Sometimes it consists of a sensation of heat extending along the whole urethra, often radiating to the buttocks, but felt most after micturition. In other persons there is often dull pain in the perinæum, a sense of weight or fulness of the rectum, rather worse by night than by day; aching above the pubes is often complained of. Micturition is called for twice or more by night. By day it is not increased in frequency. When micturition is attempted, the urine is often slow to come, and usually a few drops dribble off after the stream ceases. Walking fatigues easily, and brings on the sense of fulness in the rectum. The finger in the rectum generally finds some swelling and slight tenderness of the prostate. A sound traverses the urethra without causing pain till the bulbo-membranous portion is reached: the instrument is then grasped for a few seconds, to pass on again to the neck of the bladder; here again pain is felt, resistance is made, and the resistance ceases suddenly as the sound enters the bladder, though the pain, of a pressing or squeezing character, still remains. As the instrument is withdrawn, it is expelled rapidly until it is beyond the bulb, where it lies quietly enough and all pain ceases. When, however, the prostatic mucous membrane is also much congested, the pain attending the passage of a sound is, as already mentioned, hot or burning.

TREATMENT.—1. *Inflamed areas.*—When the pain caused by the passage of the exploring sound is acute, the resistance small, and the discharge white and thick, the condition is mainly one of congestion, which is benefited by instillations at the places where the pain is felt. A suitable solution is one of ten to twenty grains of nitrate of silver to the ounce of water, injected by means of a Guyon's bullet-catheter and syringe. This may be repeated every three or four days, while an astringent injection of alum and sulphate of zinc is used in the intervals. If there be cling or hitch as the bullet passes along the urethra, the use of a No. 25 or No. 26 (millimetric scale) steel sound, or even a larger one, twice weekly, is requisite. When no cling exists, the last remains of the discharge can sometimes be dried up by using soluble bougies at night containing chloride or sulphate of zinc in suspension (*'porte-remède Reynal'*) for ten or fourteen nights. Much may be done with injections by the patient himself when the inflammation is limited to that part of the urethra which extends in front of the triangular ligament. When the disease has extended behind that limit, very few patients can apply an injection to that portion, and the treatment must be carried out wholly by the surgeon. The injections ordinarily used for gonorrhœa are seldom sufficiently astringent to penetrate into the mucous membrane, and solutions having a strength of four or five grains of alum, as much of sulphate of zinc, and of one-fourth or one-half grain of sulphate of copper to the ounce of water, are needful in this chronic inflammation of small areas.

When congestion has produced induration, or even contraction which does not yield to gradual dilatation, the fibrous band should be divided by an urethrotome of suitable shape, until the urethrameter, expanded to the largest size in which it moves freely along the unaffected parts, travels without hitch or cling past the contracted patches. Valuable aid can be obtained by means of the endoscope, through which the inflamed patches can be attacked with mops, used under the control of the eyesight, soaked in aqueous solutions of the nitrate of silver containing 10 to 20 per cent. of the salt. Indeed, many otherwise intractable affections of the urethra are easily managed if treated endoscopically.

2. *Granular patches.*—The treatment of granular patches is tedious and uncertain without the endoscope. Something may be done by instillations of solutions of nitrate of silver of fifteen or twenty grains to the ounce of water, while the patient employs a strong injection between the sittings. But the precise

applications of stronger caustics through the endoscope is far more sure and satisfactory. Brushing the granulations with a 20 per cent. solution of nitrate of silver, or with a 1 per cent. solution of bichloride of mercury in alcohol, after scraping their surfaces with a curette, causes these granulations to disappear after four or five applications, and to leave no trace of their presence. The pain of this method is unimportant, and need not interfere with the patient's ordinary avocations. Careful dilatation of the contractions is also most necessary during the application of the caustics. In treating granular patches, the writers have abandoned the use of soluble bougies and medicated bougies of all kinds, on account of their feeble and uncertain action.

3. *Warts* yield only to topical treatment. When very small, they may be destroyed by pressing a pencil of cupric sulphate against them. They may be nipped off with scissors through the endoscopic tube. If arboriform and pedunculated, the galvanic cautery is the most effective treatment. It is well to cocaine the urethra by injecting into it ten minims of a 10 per cent. solution of hydrochlorate of cocaine, and allowing five minutes to elapse for absorption, before passing the endoscopic tube through which the topical application is made.

4. *Ulcers* are usually cured by light touches of the cupric sulphate pencil, and by dilating any stricture which may be present.

5. *Follicular sinuses.*—These often continue to secrete pus, which, escaping into the urethra, forms shreds, which appear in the urine. The best treatment is mopping with an astringent solution (10 per cent. solution of silver nitrate), or pressing into the follicle a fine point of cupric sulphate. After this application, the patient should use a strong injection to wash the sinus freely for some days. In time the sinuses cease to secrete discharge even if not treated. But before this cessation takes place, the sinus may become distended and break again, commonly into the urethra as before; rarely the collection of matter may penetrate into the erectile tissue and through the fibrous tissue to the skin, and so reach the surface of the body. When this threatens, the abscess should be promptly incised; it usually closes after evacuation without further trouble.

6. *Chronic catarrh* of the prostatic urethra is little benefited by general treatment or by drugs. Abstinence from stimulants, violent exercise, and sexual excitement are requisite; and when the secretion of pus is abundant, the specifics for catarrh, such as copaiba, cubebs, and buchu, are beneficial. But when there is little more than a shreddy discharge in the urine the proper treatment is topical. The remedies are local instillations, by a Ulzmann's curved catheter syringe, of solutions of ten, fifteen, or twenty grains of nitrate of silver to the ounce of distilled water directly on to the inflamed surfaces, made at intervals of five or seven days, the length of time being decided by the amount of reaction caused by the instillation. All soreness and increase of discharge which follows the caustic application should subside before another is applied. Usually several such instillations, with solutions increasing in strength, must be made to obtain a cure.

The use of the endoscope renders the treatment more certain and expeditious, as in treating similar patches in the anterior portion of the urethra. By this means the inflamed areas can be distinctly seen, and the remedy applied directly to them. Useful astringents in which to dip the mops are tincture of iodine, solution of perchloride of iron of the British Pharmacopœia, of mercuric chloride (1 per cent. in spirit), or of silver nitrate of 10 or 20 per cent. in water. These applications must be repeated, like the instillations, at intervals of a week or more, according to the amount of irritation they set up. Often, under most favourable conditions, the cure is slow and sometimes very tedious, but it may be always gained with patience.

7. For *chronic prostatitis*, when that is present as well as catarrh of the prostatic urethra, the treatment required is that needful for prostatitis. The general treatment is here of great value, including moderate exercise without fatigue, careful restriction of the diet to unstimulating food, tonics if required, removal of constipation, regular bathing in tepid or cold baths, occupation for the mind without lascivious or erotic excitement, and, when all congestion has been thus removed, cold injections into the rectum. Also, at this stage the passage of full-sized steel sounds, and instillations of solutions of silver nitrate into the previously cocained prostatic urethra, are among the most effective remedies for this troublesome ailment. Before caustic injections are used it is well to empty the bladder of urine, and to inject eight or ten ounces of some bland fluid, such as cold boiled water, or cold saturated aqueous solution of boric acid, with which the patient may flush out the urethra after the caustic solution has taken effect. This precaution prevents much of the soreness which invariably follows the use of strong astringents in this region. The patient should also keep his bed, or at least his room, for a couple of days after each cauterisation, to lessen the probability of an acute inflammation of the prostate or of the uvula vesicæ following the injection, of which there is always some risk.

Berkeley Hill. Charles Stonham.

GLEICHENBERG, in Austria.—Muriated alkaline waters. *See* Mineral Waters.

GLOBUS HYSTERICUS (*globus*, a ball; *hystericus*, connected with hysteria). Synon.: Fr. *Globe hystérique*; Ger. *Hysterische Kugel.*—A subjective sensation experienced by hysterical patients, as of choking, or of a ball rising in the throat. *See* Hysteria.

GLOSSALGIA (γλῶσσα, the tongue; and ἄλγος, pain).—Pain in the tongue. *See* Tongue, Diseases of.

GLOSSITIS (γλῶσσα, the tongue).—Inflammation of the tongue. *See* Tongue, Diseases of.

GLOSSO-PHARYNGEAL NERVE, Diseases of.—The glosso-pharyngeal nerve is distributed to the back of the tongue and the soft palate, the upper portion of the pharynx, the Eustachian tube, and the tympanum; and also to the stylo-pharyngeus, the middle constrictor of the pharynx, the levator palati, and the azygos uvulæ muscles. But the nerve is connected with the fifth, facial, and pneumogastric nerves, and with the pharyngeal plexus; it is certain that many of its terminal branches merely distribute fibres from these other nerves; and the early ideas of the function of the glosso-pharyngeal, founded on its terminal anatomy, are widely erroneous. Although its twigs go to the structures that subserve taste on the back of the tongue, it is certain that these, with those for common sensation in the same part and in the fauces, come from the fifth nerve; and that the fibres that innervate the palatine muscles are derived from the spinal accessory.

Paralysis.—Very little is known of the precise effects of paralysis limited to the glosso-pharyngeal nerve, since it is rarely paralysed alone. The middle constrictor of the pharynx is, however, paralysed, and the mucous membrane of the pharynx is rendered insensitive. From their position, the fibres of origin are commonly damaged in conjunction with fibres of the hypoglossal, spinal accessory, and pneumogastric. The common causes of disease in this situation are meningitis, syphilitic and other growths, and bone-diseases. The nerve may also be paralysed from disease of its nucleus of origin in the medulla oblongata, and then commonly suffers in association with the nerves to the larynx, the tongue, and often the lips (*see* Labio-glosso-laryngeal Paralysis). The sensory part of the nerve may then escape, and only the motor part be paralysed, the chief effect of which is paralysis of the pharynx. The causes of paralysis from disease of the nucleus are slow degeneration, softening, hæmorrhage, and the effects of diphtheria.

Spasm.—Nothing is known of separate spasm in the muscles supplied by the glosso-pharyngeal nerve. In conjunction with the other motor and sensory nerves to the pharynx, it takes part in the production of the spasm of hydrophobia, and in some hysterical phenomena.

Treatment.—The treatment of disorders of the glosso-pharyngeal nerve is never special, but always that of the cause, and is sufficiently described in the several articles which deal with the above-mentioned ætiological conditions.

W. R. Gowers.

GLOSSO-PHARYNGEAL PARALYSIS.—A synonym for labio-glosso-laryngeal paralysis. *See* Labio-glosso-laryngeal Paralysis.

GLOSSY SKIN.—Glossy skin is the name given to a peculiar atrophic condition of the skin, seen principally in the hands, in consequence of irritative lesions of the nerves of the forearm. The skin of the back of the hand, fingers, and even of the palm, is thin, smooth, shining, without furrows, and redder than natural—either uniformly or in patches. The skin seems as if it were stretched over subjacent parts, which are firmer than natural. It may be more or less fissured, or even denuded of epidermis in patches. Secretion of sweat may be increased or altered in quality. The parts may or may not be the seat of neuralgic pains. It was thought by Sir James Paget (who described this condition in the *Medical Times and Gazette* for May, 1864) to be a very rare affection, but it was observed by Weir-Mitchell and his colleagues, in the late American war, no less than nineteen times in fifty cases of partial division of the nerves of the forearm. It may occur also as a sequence of dislocations of the wrist, where the median nerve is compressed or otherwise damaged.

GLOTTIS, Diseases of.—*See* Larynx, Diseases of.

GLYCOSURIA (γλυκύς, sweet; and οὖρον, urine).—A condition of urine in which sugar is present; generally used as a synonym for diabetes. *See* Diabetes Mellitus.

GLYCURONIC ACID.—Glycuronic acid is a substance allied to the carbohydrates, and represented by the formula $C_6H_{10}O_7$. It occurs as an abnormal constituent of urine, as the result of ingestion of certain chemical substances, chief among which are camphor, chloral hydrate, butyl chloral hydrate, morphine salts, nitro-benzol, and some of the quinine derivatives. After chloroform (but not ether) narcosis its presence can be detected in the urine of the patient.

The presence of glycuronic acid in urine is of interest as it is liable to be mistaken for grape-sugar (dextrose), like which it is capable of reducing alkaline copper solutions (Fehling's test), as also Böttger's bismuth test (*see* Diabetes Mellitus). The possible presence of glycuronic acid ought to be kept before the mind in the examination of urine for sugar. Dextrose can be readily distinguished from glycuronic acid by its behaviour with yeast, glycuronic acid yielding a negative result when so treated. When pure it is not crystalline. It is readily soluble in water, much less so in absolute alcohol, very sparingly in ether. Its pure solutions are dextro-rotatory. The only reliable test at present known for the positive recognition of glycuronic acid is its isolation from the urine by a process long and tedious.

John Harold.

GOÎTRE.—Synon.: Bronchocele; Derbyshire Neck; Fr. *Goître*; Ger. *Kropf*; *Struma.*

Definition.—Simple hypertrophy, or cystic, fibroid, or fibro-cystic enlargement of the thyroid gland.

Ætiology.—*a. Locality.*—Goître is prevalent in magnesian-limestone districts, for example, Derbyshire—hence the name 'Derbyshire neck.' Amongst the continental countries it prevails in are France, mostly in Savoy; Germany, mostly in the Black Forest; Austria, mostly in Styria; Northern Italy, mostly about the Alps; Switzerland, mostly in the Valais; and Russia, mostly about the Altai mountains in Siberia.

Goître is not only indigenous to mountainous districts, as has been supposed, but it is present in some plains—for instance, the plains of Lombardy.

b. Water-supply.—Goître is due in a large number of cases to an impurity in potable water. Snow-water was in former days considered to be the cause, but this opinion is met by the statement that goître does not exist in Greenland or Lapland, and that it is prevalent in Sumatra, where there is never any snow. The impurity has been stated by many to be due to an excess of lime and magnesia, which theory seems borne out by a geological examination of the localities in which goître is indigenous in England. In parts of the Indian Punjaub, where goître affects 60 per cent. of the population, 59 grains of lime have been found in a gallon of water, '10 grains being an undesirable proportion' (Professor Frankland). On the other hand, in many limestone localities bronchocele is entirely absent. Scotland, Ireland, Norway, and Sweden are comparatively exempt from the disease, although mountain limestone is found largely present in their geological formation. Several observers have attributed goître to the presence of iron pyrites in the water-bearing strata. Dr. Thursfield, of Shrewsbury, who has personally investigated the disease in various parts of England, believes that impure water, although not always or necessarily a factor in the production of goître, is frequently a strongly predisposing cause; and that when this is the case, the impurity in the water which causes goître is undoubtedly protoxide of iron in carbonic solution. Thus is explained the fact that goître is so often found in magnesian-limestone districts; for iron pyrites, when brought into contact with water containing carbonate of lime and magnesia in carbonic solution, passes by a process of oxidation into the soluble carbonate of iron.

c. Other causes.—Epidemics of goître have been notified as chiefly occurring amongst soldiers in France, probably the result of forced marches through goitrous districts, combined with scarcity of food. In such districts the practice of carrying loads on the head seems largely to increase the ratio of the disease. Dr. Thursfield has proved by investigation, spread over many years, that goître has largely decreased in those districts where the practice of carrying weights on the head has decreased, although there has been no other change in the habits of the natives, nor in the condition of the water of the district. He has found that much walking up and down hills, diminished barometric pressure, and child-bearing are factors in goitrous districts. He believes goître, if endemic, to be essentially a disease of childhood, disappearing at adolescence unless the above-mentioned causes are brought into play. He has also noted that 'the influence of heredity, direct, collateral, and atavistic, is most strongly marked'; and 'that intermarriage in comparatively isolated communities, acting through successive generations, is a potent predisposing cause in the local prevalence of goître.'

Women in this country are much more liable to suffer from bronchocele than men, perhaps on account of their being more frequently water-drinkers, for in India it has been noticed that both sexes suffer alike. Besides, there is an association between the enlarged gland and the uterine functions. During the time of puberty the disease commonly first attracts attention, although it may occur from any time of life up to forty years of age, children having even been born with a thyroid enlargement.

Anatomical Characters.—The whole of the thyroid gland, or both lobes, or one lobe only, may be the seat of the goitrous enlargement. The isthmus is rarely affected by itself. In exceptional cases an accessory lobe is present, and becomes enlarged. The enlargement may be simple soft hypertrophy of the gland, cystic, or fibroid; or cysts may be found interspersed in the substance of a fibroid enlargement. Cysts are formed from the normal follicles of the thyroid, by their distension with colloid material, the epithelial lining degenerating as the cysts increase in size. The cyst-wall is formed by the interlobular septa and capsule of the gland. In pure cysts the serous fluid which is secreted from the walls replaces the colloid contents. In the fibroid form the connective stroma increases at the expense of the follicles, and tough bands of nucleated fibrous tissue traverse the organ in all directions, the change generally commencing centrally and extending peripherally. The follicles mostly atrophy, but some may persist in the form of small cysts.

Symptoms and Complications.—The appearance of the swelling, and a sense of fulness in the neck, are often the only symptoms of goître. Added to the sense of fulness, there may be a feeling of dragging or constriction about the throat. More serious symptoms are sometimes present—namely, dysphagia and dyspnœa. The former is rarely present except when the tumour has reached an immense size, or when it presses on the œsophagus, as happens when the lateral lobes meet behind the gullet. Dyspnœa, a more common symptom, may be due to pressure from the goître on the front and sides of the trachea (found more commonly in young people, before the tracheal rings have gained much power of resistance), or on both recurrent laryngeal nerves, causing partial paralysis of the abductors of the vocal cords (crico-arytenoidei-postici muscles); or to a portion of the gland passing behind the trachea, or becoming enlarged beneath the sternum. There is often a temporary enlargement of a goître during the catamenial period and pregnancy; and flooding in childbirth is not uncommon. A tendency to the hæmorrhagic diathesis has been noted. Exophthalmos, with palpitation of the heart, may accompany goître. *See* Exophthalmic Goître.

Goîtres in some countries are allowed to reach such dimensions that the inhabitants have to support them in bags. A cystic goître projects externally far more often than the fibroid variety.

Cretinism is met with, but rarely, in the goitrous districts of this country. More than half the number of cretins are born of goitrous parents; but a goitrous enlargement need not necessarily be present in a cretin, for instances of cretinism have been reported in which the gland has been entirely absent; still they have the same ætiological connexion. When the thyroid gland is absent and cretinism prevails, the late Dr. Hilton Fagge believed that fatty tumours will be found, almost without exception, in the posterior triangles of the neck. *See* Cretinism; and Myxœdema.

Diagnosis.—A soft hypertrophy of the thyroid gland can be diagnosed by its general diffusiveness, and the want of consistent hardness.

The presence of a cystic goître can be ascertained by the fluctuation of fluid within its walls. Illumination of the sac for the purpose of diagnosis is of no use. Any doubt can be cleared up by passing a very fine trochar into its centre. Owing to the fact that some cystic goîtres contain a large amount of soft trabecular structure, the fluid withdrawn is likely to be mixed with blood. When the fluid has been entirely withdrawn from a pure cyst, it often happens that blood will be freely discharged from the mucous walls.

A fibroid enlargement of the thyroid gland can be diagnosed by the consistency and hardness of its substance. In some cases, fibroid nodules lie scattered in a general hypertrophy of the gland, and may be of stony hardness. Some difficulty may be experienced in distinguishing between a globular fibroid and a small cystic goître that has thick walls, both of which lie deeply in the neck; but if the exploratory examination be made, as recommended above, the difference can at once be recognised.

The diseases which simulate goître are cancer of the thyroid gland; calculus embedded in its substance; lymphadenoma; aneurysm; and fatty and other tumours of the neck. A leading point in making a diagnosis is to ascertain, by directing the patient to swallow, whether the swelling is attached to the trachea. In the cases of cancer and lymphadenoma, the history and general condition of the patient will give a leading clue. In connexion with cancer, it must be borne in mind that a fibroid enlargement of the gland may become the seat of carcinomatous change. When a fibrous goître closely overlies the carotid artery, it simulates an aneurysm, owing to the forcible pulsation conveyed through its substance.

Prognosis.—The prognosis in goître is favourable. The occurrence of death from suffocation, due solely to the effects of a goitrous enlargement, is rare. It occurs in those countries where little or no treatment is tried, the tumours being allowed to attain an immense size—their weight sometimes reaching several pounds. The disease is more likely to endanger life when the gland passes behind the trachea, and completely embraces it. All the varieties of goître are amenable to treatment, but especially the cystic. Goîtres have been known to disappear without any treatment. This result may be due to the removal of the affected person from endemic influences; or it may happen when the enlargement has arisen during pregnancy.

Treatment.—The general rules requiring attention are removal of the patient from a goitrous district, or complete abstinence from the drinking-water, unless it has been ascertained to be perfectly innocuous, also from carrying weights and ascending hills. General medicinal remedies are only of service when the gland is enlarged by fibroid change, and then iodide of potassium (two to three grains twice a day) may be tried. When the hypertrophy is of the simple soft form, blistering, or painting the surface with the tincture of iodine, or the use of iodine ointment, will be sufficient. If the enlargement is fibroid and of some consistence, then injections of the tincture of iodine into, or setons passed through, the substance of the gland, are most useful. Fluoric acid has been given internally, with or without the injections, in some cases with success. The injection of ♏xv to ʒj of tincture of iodine should be used twice a week, then weekly, and afterwards fortnightly. The greater number of cases answer well to this treatment, whilst on others no impression can be made. The time the treatment takes depends on the size of the goître; a month is the minimum required for the cure of a very small goître. The process to be followed when injecting is as follows: Having frozen the skin over the portion decided upon for injection, by means of the ether spray, and care being taken to avoid transfixing any vein, or the trachea, the needle of the syringe is pushed into the substance of the goître, and the fluid injected slowly. The best form of syringe for the purpose is one similar to that used for hypodermic injection, made with a screw-piston. Pain in the course of neighbouring nerves is sometimes felt during the injection, for instance in the ear, or at the root of a tooth. When the operation is finished, the needle should be rapidly withdrawn, and the skin where the puncture has been made rolled between the finger and thumb, to prevent any escape of the iodine. If the needle be passed well into the substance of the goître, no fear need be entertained of the formation of an abscess. In favourable cases there will be a gradual enlargement of the tumour, with a slight degree of pain, for some eight or twelve hours; after that time the bronchocele will very slowly decrease in size. As a rule, in two or three weeks' time it will be evident whether the injection is to prove effective. By this form of treatment all scars are avoided. The length of time required for its adoption is often an objection, even when improvement is noted; a case occurred in the writer's experience in which the time needed for the completion of the cure was over a year, the neck being reduced from $17\frac{3}{4}$ to $13\frac{1}{2}$ inches. Setons made of from two to eight lengths of silk form a very serviceable plan for the treatment of fibrous goîtres. In employing either injections or setons, there may be a slight rise of temperature, but it is rarely necessary for the patient to discontinue his usual employment.

Biniodide of mercury smeared over the enlargement, the patient being then made to sit with his neck exposed to the rays of the sun for many hours, has proved an effectual remedy in India. A Captain Cunningham, the originator of this plan, treated gratuitously about 60,000 natives in two years. He is said to have never produced salivation, and to have rarely failed in effecting a cure. Ligature of the thyroid arteries has only proved of temporary benefit. Division of the isthmus has been advised when dyspnœa is present. This operation may cause the rest of the gland to diminish. A goître may be removed when it endangers life or keeps the patient from work. The operation, though a serious one, is of comparative safety under the antiseptic system, and when each vessel is divided between ligatures. Entire removal of the gland is, unhappily, often followed by myxœdema. *See* MYXŒDEMA.

The treatment of cystic goître is of one kind, unless removal of cyst is practised, and is always successful. The plan consists in emptying, or partially emptying, the cyst with a trochar and cannula, and then injecting a solution of iron (two drachms of the solution or tincture of the perchloride to an ounce of water) sufficient to expand the cavity again. The patient should be kept in bed on account of the rise of temperature, after a successful injection, with the cannula plugged, until the third or fourth day, when a suppurative discharge should have been set up. Should the injection not be successful, it can be repeated at intervals of a few days, until a discharge is established. The metal cannula should then be replaced by an indiarubber one (made with a middle layer of webbing), the cannula being cut shorter as the cyst becomes smaller, and poultices applied until the goître has disappeared. A cure will be effected in one month to four or five months.

During the injection of the iron solution into cystic goîtres, it may happen that air passes into a vein which has been wounded by the trochar. As this accident has been followed by instantaneous death, the writer, to prevent it, uses conjointly the two following plans, taking care to avoid superficial veins: (1) A tape is passed round the neck under the base of the goître, and held tightly by an assistant standing behind the patient, whilst the injection is going on, and for two or three minutes after. (2) The nozzle is fixed at right angles to the body of the syringe, to enable the injection to be made without holding the syringe below the level of the opening into the cyst, thus preventing the injection of air. *See* THYROID GLAND, Diseases of.

PUGIN THORNTON.

GONAGRA (γόνυ, the knee; and ἄγρα, a seizure).—An attack of gout in the knee. *See* GOUT.

GONARTHRITIS (γόνυ, the knee; and ἄρθρον, a joint).—Inflammation of the knee-joint. *See* JOINTS, Diseases of.

GONORRHŒA (γονή, seed; and ῥέω, I flow).—SYNON.: Clap; Blenorrhagia; Fr. *Chaudepisse*; Ger. *Tripper*.

DEFINITION.—A contagious purulent inflammation, affecting primarily, in men, the urethral, and in women the vaginal mucous membrane. Occasionally the conjunctival and rectal mucous membranes, to which the nasal has been added on doubtful evidence, are attacked by gonorrhœa. Certain rheumatoid affections and other complications, to be subsequently mentioned, may also attend the disease.

Ætiology.—True gonorrhœal inflammation is due to inoculation of discharge from a surface already the seat of gonorrhœa. Membranes covered by pavement epithelium, and possessing a rich lymphatic supply, are the most readily affected; those covered by columnar epithelium, *e.g.* the rectum, are not so liable to become diseased; while the mucous membrane of the mouth, stomach, and air passages appears to be exempt. Healthy mucous membranes are as liable to contract the disease as are those the seat of some morbid change. Although it is highly probable that gonorrhœa arises from gonorrhœa alone, there are cases met with of acute purulent inflammation of the mucous membranes of the vagina, uterus, bladder, conjunctiva, &c., where the disease appears to have arisen independently of contagion from specific gonorrhœal pus. It is therefore better, in the present state of our knowledge, to admit the possibility that contagious inflammations of these mucous membranes may originate from contact with pus secreted by acutely inflamed surfaces which have not been primarily affected by gonorrhœal poison. There are, moreover, great difficulties attending the isolation and cultivation of the micro-organism found in acute gonorrhœa—the gonococcus of Neisser. Previous to the discovery of this organism, various authors suggested and described certain forms of vegetable life which they maintained constantly appeared in gonorrhœal pus, and to which they attributed causative properties when inoculated on suitable mucous membranes.

In 1879 Neisser first described a diplococcus found in gonorrhœal pus, which he believes, and states that he has proved by experimental cultivation, to be the proper organism exciting gonorrhœa. This diplococcus, arranged in pairs or fours separated by a clear interval, is found on the surface and in the interior of the pus or pavement-epithelium cells, and also freely floating in the liquor puris; the organism is never found in the nuclei of the cells. The diplococcus is most numerous in the discharge from a recently infected case, and least so when the disease is of long standing. It is not at present proved incontestably that the diplococcus in question is really the specific poison of gonorrhœa. A very similar organism is found in the buccal mucus of some persons; and even in gonorrhœal pus it is often accompanied by other organisms which are at home in discharges not connected with gonorrhœa. The diplococcus gonorrhϾ is cultivated with great difficulty. Neisser has cultivated it in human blood-serum, but many other observers, repeating his experiments, have failed to do so. Neisser declares that he has produced a contagious urethritis by inoculating the cultivated microbes in the human urethra. Bockhart claims to have met with similar success. Other observers state that they have found the gonococcus in the fluid from acutely inflamed joints, and even in the blood itself in cases of rheumatism originating in urethral gonorrhœa. It is theoretically assumed that the organism penetrates and multiplies in the epithelium cells, and advances into the underlying lymphatic spaces. Here it rapidly proliferates, exciting inflammation and exudation, the migrated leucocytes containing the microbes. The process advancing, the diplococci pass into the substance of the corpus spongiosum, to the glands and lacunæ of the urethra, to the erectile tissue of the corpora cavernosa, &c., and light up inflammatory mischief in the parts affected. The facility with which the gonococci pass along the lymphatics explains why certain portions of the urogenital canal, *e.g.* the navicular fossa, bulb, neck of the bladder, and epididymis, are the parts most commonly affected. Moreover, the microbes, aggregated into masses, may be carried away in the lymphatic and blood currents as infective emboli; this would explain the occurrence of gonorrhœal rheumatism, endocarditis, &c.

Adopting the theory of phagocytosis, it may be supposed that the white cells, and others acting as phagocytes, are hostile to the development of the gonococcus, and this may serve, in some measure, perhaps, to explain the fact that different persons and organs are not equally affected by the gonorrhœal poison; in certain persons or organs their innate strength of resistance to infective poisons may be sufficient to destroy the microbes or arrest their development. When the proliferation of the poison takes place mainly in the pus-cells, the microbe has but little power, and consequently the course of the disease is mild; but if the organisms develop freely in the liquor puris the course is usually severe, and specially marked by involvement of lymphatic structures, giving rise to lymphangitis and bubo.

Assuming the gonococcus to be the active exciting cause of the disease, there are yet certain predisposing causes which may exert an influence on the development of the poison, and so augment or modify the severity of the disease.

First, there is no doubt that the urethral mucous membrane differs greatly in its susceptibility to inflame in different individuals. It is, moreover, asserted that both sexes grow accustomed to the contagious secretions of the same individual, so that they neither infect nor are infected by their usual companions, while they readily receive from or impart disease to strangers.

In women the arrangement of the genital mucous membrane favours the retention of secretions coming in contact with it. Among other causes favouring the development of gonorrhœa may be mentioned the presence of gleet, alcoholic excess, and previous attacks. Men with slight hypospadias are specially liable to contract gonorrhœa.

Incubation Period.—The symptoms of gonorrhœa are not usually manifested until four or five days after infection: presumably the contagion needs this time for multiplication and development before it is capable of exciting inflammation. According to circumstances, the incubative stage may be shortened or prolonged, ranging from two to eight or ten days. As a general rule, the shorter the incubation stage the more severe is the disease. The period of incubation in the case of gonorrhœal conjunctivitis is shorter than that of urethritis, varying from six to seventy-two hours, the average time being about twenty-four hours.

Gonorrhœa differs so considerably in the two sexes, owing to the difference in the seat of the affection, that it will be advisable to describe it in the male and female separately.

(*a*) **Gonorrhœa in the Male.**—Anatomical Characters.—The fossa navicularis, rich in follicles and their ducts, is the primary seat of gonorrhœa in the male. The poison passing into the ducts remains in security during the period of its development and multiplication, and penetrates into the deeper tissues and lymphatic network. As the disease progresses it gradually passes backwards by direct extension, but often pauses at the bulb or membranous part of the urethra. In more severe cases the disease may extend to the submucous tissue, the prostatic urethra and prostate, neck of the bladder, epididymis, bladder, and kidneys. Pyelitis and nephritis are less often the result of direct extension of the inflammatory process; more commonly they are the result of sympathetic irritation, especially in cases where the neck of the bladder is involved.

In the acute stage of gonorrhœa, the mucous membrane, where inflamed, will be deeply congested and of a bright red colour; it is swollen, and the epithelium on the surface proliferates and desquamates. A thick, creamy, purulent discharge soon makes its appearance. The dorsal lymphatics are often found enlarged and tender, and the inguinal glands are not infrequently involved and may suppurate. As the disease subsides, the inflammation dies away first in those parts first attacked; the redness will then be less marked, and is often punctiform and patchy. When the disease subsides, the products of inflammation are absorbed by the lymphatics.

In more severe cases the surface epithelium may be destroyed, and small ulcers and erosions formed; these may subsequently form granular patches (*see* Gleet), and may ultimately give rise to stricture. This necrosis of tissue very rarely extends beyond the submucous tissue. The ulcers may heal without producing any ill effects. If, however, they become chronic, fibrous tissue develops in their bases and gradually tends to contract; in other cases granulations spring up, and may develop into warty growths, similar to those seen round the corona.

From the varieties of intensity of the inflammation, various appearances are produced which have given rise to a distinctive nomenclature being applied to them; thus: (1) In some cases several layers of epithelium-cells are raised into small eminences by serous effusion; these burst and leave small erosions—*phlyctenular gonorrhœa.* (2) The inflammatory lymph, entangling leucocytes in its meshes, may form a continuous, more or less tough, membrane on the surface, which can be peeled off in flakes—*diphtheritic gonorrhœa.* (3) If the discharge is copious, and mixed with much serum and mucus, the case is sometimes spoken of as *catarrhal.*

Symptoms.—Clinically, gonorrhœa may be conveniently divided into three stages corresponding with the development, period of vital activity, and destruction of the poison.

During the *first* or *incubative stage* there is some tickling and itching at the meatus and tip of the penis, and slight scalding on micturition. A feeling of heat, tension, and weight in the testicles and perineum is often complained of. Nocturnal erections and emissions are not uncommon, and the sexual appetite is increased. Micturition is more frequent than usual. These symptoms may be so slight as to be unnoticed by the patient, and only come on during the latter half of the incubative stage.

In the *second* or *acute inflammatory stage* the signs are pronounced. The lips of the meatus are swollen and red, the urethra is tender to the touch, and the corpus spongiosum is swollen and engorged. The discharge soon makes its appearance; at first it is sero-purulent and scanty, but in a very short time it becomes greenish-yellow, thick, creamy, and copious. Micturition is frequent and painful; in consequence of the swelling of the urethral walls, the stream of urine is diminished in size, or it may escape in drops. The pain and scalding are often severe, especially if raw patches are present in the passage, or if the urine is concentrated and highly acid. Swelling and tenderness of the dorsal lymphatics are common, with enlargement of the inguinal glands (sometimes but not usually going on to suppuration). In more severe cases the whole penis becomes tender and swollen, and the subcutaneous veins engorged. As the disease spreads to the erectile tissue of the corpora cavernosa, it becomes infiltrated with inflammatory exudation, and the affected parts are no longer able to be distended with blood. Consequently, erections, which are very troublesome at night, are only partial, and the straining and tightening of the inflamed parts, by the distension of the uninflamed, produces severe pain, and alteration of the shape of the erect penis—chordee.

In some cases copious hæmorrhage occurs from the distended parts. Small quantities of blood, giving a red tinge to the discharge, may also come from ulcerated and eroded areas of the inflamed mucous surface.

Peri-urethral swellings, giving the urethra a beaded feeling, are by no means uncommon, especially at the fossa navicularis and bulb. They are due to follicular inflammation, and to exudation into the spongy tissue round the urethra. If this be very acute, peri-urethral abscess may result.

When the disease spreads to the membrano-prostatic urethra and neck of the bladder, there is almost constant desire to micturate, with great pain and spasm following the act. Towards the end of micturition a few drops of pus and blood may escape. The discharge is less copious, and the urine often turbid from admixture with muco-pus, which forms a plentiful deposit. From inflammatory congestion of the passage micturition may be difficult, the urine dribbling away. In other cases the irritation in the passage excites spasm of the compressor urethræ muscle, resulting in complete retention. When the disease has extended so far back there is distinct heat and pain in the perineum; if the patient have an emission of semen, which is likely on account of the inflammatory irritation of the verumontanum and ejaculatory ducts, the act will be painful, as if something had been torn in the perineum. The semen, instead of escaping in jets, gradually trickles away, and is often mixed with and followed by a few drops of blood. In cases of gonorrhœa, fever may or may not be present; it is usually slight and transient, unless the disease be complicated. The duration of this second stage varies according to the severity of the disease, the treatment adopted, and the care of the patient himself. Usually the acute stage passes off gradually in from three to six weeks. The symptoms are, *cæteris paribus*, more severe in a first attack, but subsequent ones are more likely to become chronic.

After a varying time the acute inflammatory stage of gonorrhœa passes into the *third*. The symptoms may gradually abate, the pain and discharge disappearing, and the disease terminate. In other cases the discharge becomes less in quantity, more watery, and of a sero-purulent nature; the other symptoms disappearing. Lastly, all the signs may subside with the exception of a thin whitish discharge, especially noticeable in the morning. In such cases the disease persists in a patchy form, and constitutes gleet. *See* GLEET.

During the third stage the acute symptoms may at any time be lighted up again if the treatment be abandoned, or in consequence of injudicious conduct on the part of the patient.

DIAGNOSIS.—Acute urethritis is not invariably gonorrhœal; and it may be of great importance, especially in cases likely to lead to legal proceedings, to determine whether the urethral mischief be gonorrhœal or not. Much credence must not be placed on the patient's statements. Certain complications are said only to follow gonorrhœa, and no other form of urethritis; but this is not so clearly established as to be of certain diagnostic value. In cases where a definite opinion as to the venereal nature of the case is necessary, the pus should be examined for the gonococcus by staining with fuchsin or methyl violet. But, as already stated in discussing the ætiology of gonorrhœa, there is still some doubt as to the specific properties of this organism.

Urethritis may be easily distinguished from urethral chancre; but it must be remembered that both conditions may be present. Urethral chancre is nearly always situate just within the meatus, never more than one inch from it; the ulcerated surface can be seen if the lips of the urethra be separated, and a short aural speculum introduced.

The discharge from a chancre is not creamy, but shreddy, and the pain during micturition is stinging and limited to the raw surface. Occasionally a slight muco-purulent discharge, without pain or much swelling, is present during the initial stage of syphilis, but it subsides spontaneously in one or two weeks, and is accompanied by the indurated sore, and succeeded by secondary symptoms.

In balanoposthitis (which may or may not be venereal in origin) there need be no urethral discharge. This can be ascertained by thoroughly syringing away all the pus from under the prepuce, and then squeezing the penis to see if pus escapes at the meatus.

Prostatic and perineal abscesses may discharge into the urethra. In such conditions the discharge, profuse on one occasion, at once subsides to a scanty gleet. They may be diagnosed by the history of the case, and a careful examination of the patient, but it must be borne in mind that they occasionally complicate gonorrhœa.

PROGNOSIS.—The prognosis of gonorrhœa is usually favourable if proper precautions be taken early. But, in spite of attention and care, the disease is sometimes very severe, especially in young lads of lymphatic temperament, or in men of nervous, irritable constitution. Gonorrhœa is said also to be liable to run a severe course in persons who suffer from acne. It is more likely to become chronic after repeated attacks, and in those who suffer from stricture or have a narrow meatus.

Various complications, to be afterwards referred to, may arise in the course of the disease, and certain sequelæ follow it. In rare cases gonorrhœa terminates fatally by general pyæmia, or more frequently may lead to joint-affections of more or less severity.

Treatment.—The so-called *abortive* treatment of gonorrhœa has, on account of its non-success and attendant risks, been practically abandoned, and calls for very short notice here. It consists in the internal administration of large doses of copaiba or cubebs, or of injections of caustics or strong irritants and astringents. The former are open to the objection that they not infrequently produce marked constitutional disturbance, and moreover are unsuccessful in attaining the object in view. Strong injections too often aggravate, instead of relieving, the local mischief, and may thereby make the course of the disease more severe and chronic. In the early stages of acute gonorrhœa, rest, if the patient can take it, is important. The bowels should be opened and kept acting by the use of saline aperients, and the diet should be low and of a non-irritating description. All alcohol, especially malt liquors, highly seasoned dishes, great exercise, and sexual excitement should be rigorously avoided. Warm baths and strict cleanliness of the parts, with support of the penis and testes, are useful. The salts of potassium, with tincture of hyoscyamus, are also useful, to diminish the acidity of the urine, and allay the smarting and pain during micturition; the same may, if excessive, be relieved by immersing the penis in iced water during micturition. In extreme cases, cocaine may be injected before micturition. As long as there is much smarting and signs of acute inflammatory congestion, strong astringent injections should be avoided, but relief is obtained by washing out the urethra with tepid water after micturition. One-eighth gr. of permanganate of zinc to one fluid ounce of distilled water is an injection which may generally be employed in the earliest stage. When the acute stage has passed, the continuance of the congestion is shortened by astringent and antiseptic injections, and the internal administration of copaiba, sandal oil, or cubebs. Injections should not be strong at first—2 to 3 grs. of sulphate of zinc to the ounce being sufficient. The patient should be directed to pass his water, and then wash out the passage with a little tepid water; after that the injection should be used, and kept in the urethra for two minutes. Many substances are used as injections, and it is difficult to say in a given case which will suit best. Sulphate of zinc grs. 2 to ℥j, or mixed with acetate of lead; chloride of zinc gr. $\frac{1}{4}$–gr. 1 to ℥j; sulphocarbolate of zinc grs. 2 to ℥j; permanganate of zinc gr. $\frac{1}{8}$ to ℥j, are all useful. Alum, acetate of lead, hydrastis, and the extract of belladonna may also be used. Extract of belladonna should not be used with permanganates, as they form an explosive mixture. The mercuric chloride in solutions of various weakness, $\frac{1}{3000}$ to $\frac{1}{2000}$, is used on theoretical grounds by some; but in the writers' experience they are most uncertain, and more often excite irritation than allay it in the urethra.

Whatever injection is chosen, it must be used judiciously, and care taken that it does not aggravate the condition it is intended to benefit. As a rule, the injection should be made at least three times a day by the patient; if the membrano-prostatic urethra be involved it may be necessary for the surgeon to apply astringents himself (*see* Gleet). Iodoform and eucalyptus bougies are highly thought of by some; they should be introduced at night. The writers have not seen any great benefit follow their use. If the injections increase the discharge, or heighten the soreness, they should be abandoned, and soothing internal remedies alone given. The chief internal specifics are copaiba, sandal oil, and cubebs; infusion of uva ursi, Canada balsam, tolu, turpentine, and benzoic acid. They are often beneficial, but are apt to cause dyspepsia; and, in the case of copaiba, sandal wood, and Canada balsam, congestion of the kidneys, especially in the later stages of the disease. These remedies should be given thrice daily for several weeks. In the later stages the preparations of iron in combination with quinine are often useful.

Chordee is frequently a very troublesome symptom, for, in addition to the pain it causes, the patient's rest is broken, and consequently his health weakened. Perhaps the most useful remedy is a suppository at night of opium or belladonna in combination with camphor (1 gr. and 3 grs.); bromides, chloral hydrate, cannabis indica, and lupulin are also useful; while the erection can be immediately stopped by the application of cold water. In some cases a hot bath just before going to bed, with the use of the suppository mentioned, will prevent chordee. When gonorrhœa becomes chronic, accompanied by a gleety discharge, further treatment may be necessary. *See* Gleet.

Complications and Sequelæ.—Various complications may arise during the progress of gonorrhœal urethritis; many of these are referred to in special articles, to which the reader is referred for information.

1. *Balanitis* and *Balanoposthitis*.—*See* Balanitis.

2. *Phimosis* and *Paraphimosis*.—*See* Penis, Diseases of.

3. *Retention of urine* may occur in consequence of swelling of the mucous mem-

brane, and muscular spasm closing the passage at the membrano-prostatic portion; this is specially likely to occur if there is inflammation of the neck of the bladder. Under the influence of warm baths, saline aperients, rest, and morphine suppositories, the congestion is lessened, and the temporary retention is usually relieved. It causes great pain and anxiety when present. Gonorrhœa affecting a patient who is the subject of stricture may, by causing acute congestion of the narrowed portion of the urethra, temporarily occlude the passage and cause retention. The treatment is the same as given above; in both cases it may be necessary to pass a fine soft instrument in order to afford immediate relief. In the case of stricture further treatment will be necessary when the gonorrhœa is cured. *See* MICTURITION, Disorders of.

4. *Lymphangitis* and *Bubo*.—*See* BUBO; and LYMPHATIC SYSTEM, Diseases of.

5. *Hæmorrhage from the urethra*, if profuse and continuous, is probably due to rupture of the corpus spongiosum during erection. A few drops of blood may come away with the discharge or after micturition; this may be due to rupture of the congested vessels, or to the presence of a granular patch, and needs no special treatment. If hæmorrhage is continuous, ice will be serviceable in arresting it, and hamamelis may be injected. In some cases a catheter may be passed, and the penis compressed by a bandage. *See* HÆMATURIA.

6. *Peri-urethral abscess* may occur close to the glans penis, between the layers of the perineal fasciæ, or in the glands of Cowper. Peri-urethral abscess may cause acute symptoms, but is often chronic in its progress. The pus may escape into the urethra, externally through the skin, or both ways; in the latter case a urinary fistula is formed, which will, however, usually heal in time. When peri-urethral abscess is diagnosed, it should be freely opened; if the abscess has originated in a distended follicle, and has burst into the urethra, it may be treated successfully by laying it open, through the endoscopic tube, with a canaliculus knife.

7. *Inflammation of the neck of the bladder*, often erroneously spoken of as cystitis, is due to extension of the disease to the membrano-prostatic urethra. Cystitis itself is a rare complication. This complication does not usually come on until the second or third week; it causes much pain and spasm, and has a very depressing effect on the patient's general health.

Inflammation of the neck of the bladder causes great frequency of micturition, with pain during and scalding at the end of the act, caused by muscular spasm. A few drops of blood usually escape after the urine, with a little muco-pus. The usual gonorrhœal discharge ceases almost entirely during the attack, but usually returns when the inflammation of the neck of the bladder subsides. Relapses are common.

Low diet, warm baths, rest, and anodynes will prove of great value in this complication.

When the bladder itself is affected, the disease usually attacks the base, and may spread to the kidneys. The inflammation may be acute or chronic, and may attack the mucous membrane only, or the whole thickness of the wall (parenchymatous cystitis). *See* BLADDER, Diseases of.

8. *Prostatitis* and *prostatic abscess*.—Prostatitis is a severe complication of gonorrhœa. It is due to the spread of the disease to the uvula vesicæ, and along the prostatic ducts to the body of the gland. It may be excited by injudicious treatment, wet and cold, or venereal excitement during gonorrhœa. The disease may run on to suppuration, or may become chronic.

In the acute form the gland is swollen and tender, causing painful and difficult micturition, and sometimes retention. There is a sense of weight, heat, and fulness in the perineum and above the pubes, with rectal irritation and pain on defæcation.

Should suppuration occur, the local and constitutional symptoms deepen. Eventually the abscess bursts, commonly into the urethra, more rarely into the rectum or bladder or on to the perineum. The treatment is the same as that described for inflammation of the neck of the bladder, combined with the passage of a catheter if retention should occur, and the evacuation of pus as soon as it shall be diagnosed. Such abscesses are best opened through the perineum; should they burst into the urethra they will usually heal spontaneously; if not, a perineal opening must be made. *See* PROSTATE, Diseases of.

9. *Epididymitis* and *orchitis*.—Inflammation of the epididymis is the most frequent complication of gonorrhœa. The disease is usually unilateral, but in a small proportion (3·5 per cent.) of cases both sides are affected. The spread of gonorrhœa to the epididymis is much more commonly seen among hospital out-patients than among private patients, doubtless because the latter take more care of themselves. The epididymis is not affected until the urethritis has spread backwards to the membrano-prostatic portion—*i.e.* towards the end of the third week. *See* TESTES, Diseases of.

10. *Inflammation of the rectal mucous membrane* occasionally occurs, more especially in women. It is due to direct inoculation of the discharge. There is smarting and burning pain, much increased on defæcation. The mucous surface is bright red, and may be granular and ulcerated. A yellowish discharge escapes *per anum*. Thorough cleanliness, with the use of astringent lotions, will effect a cure.

11. *Gonorrhœal conjunctivitis* is a very grave complication, especially if not seen early, as it may destroy the whole eye. The patient should be warned that no discharge from the urethra must be allowed to get near the eye. *See* Eye, and its Appendages, Diseases of.

12. *Sclerotitis* and *iritis* occasionally occur in the course of gonorrhœa, but are very rare. *See* Eye, and its Appendages, Diseases of.

13. *Rheumatism* of the joints, fasciæ, and great nerves, &c. *See* Rheumatism, Gonorrhœal.

14. *Stricture* may occur as a sequela. It usually follows granular urethritis, resulting from gonorrhœa. Some months or even years elapse before the stricture is established. *See* Urethra, Diseases of; and Gleet.

15. *Warts* may occur on the glans penis or in the urethra. *See* Gleet; Penis, Diseases of; Verucca.

(*b*) **Gonorrhœa in the Female—Vaginitis.** — Morbid Anatomy. — In the female, gonorrhœa first attacks the lower part of the vagina, and may spread to the vulva and urethra, or upwards to the upper part of the vagina and the uterus; and, by continuous extension, to the Fallopian tubes, peritoneum, and ovaries in one direction, and to the bladder, ureters, and pelves of the kidneys in another direction, besides attacking the joints, fasciæ, and eyes with rheumatic inflammation as in the male subject. The disease may become chronic, and be accompanied by complications to be afterwards mentioned.

In the first stage the mucous membrane is congested, swollen, and tender; the parts are drier than natural, in consequence of a diminution of the natural secretions; but in a few hours there is a thin transparent mucous discharge, which quickly becomes sero-purulent, purulent, creamy, and copious. The discharge when fully established has often a greenish tinge, and is offensive and highly irritating. The affected mucous membrane is often studded with little eminences due to enlargement of the papillæ (vaginitis granulosa). In more severe cases patches of erosion may be seen, especially if the disease spreads to the os uteri. Owing to the irritating nature of the vaginal discharge the vulva becomes inflamed, swollen, and excoriated. The glands of Bartholin not infrequently become involved, and suppurate. The inflammation becomes chronic in from six to ten or twelve days, the pain, swelling, and congestion subsiding, and the discharge, now muco-purulent, remaining plentiful. In the chronic form, the upper part of the vagina, the *cul de sac*, and the neck of the uterus are the parts specially involved. They are of a brighter colour than the rest of the mucous membrane, and secrete the discharge. Not infrequently, when the inflammation has ceased in the vagina, pus can still be squeezed from the meatus urinarius or some of the crypts opening round that orifice, if the finger be drawn forwards along the under-surface of the urethra.

Symptoms.—In the acute stage there is heat, itching, and swelling of the parts, smarting on making water, aching pains in the back and loins, with great tenderness on examination. The bright red colour of the congested mucous membrane, together with the offensive greenish purulent discharge from the surface, is sufficient evidence of vaginitis, but is not sufficient to determine its specific origin. As the disease becomes more chronic the acute symptoms pass away, but there is still a plentiful discharge.

Diagnosis.—The diagnosis of vaginitis and vulvitis is easy, but it is sometimes impossible to speak with certainty as to its gonorrhœal origin. The actual source of the discharge should be ascertained, since copious yellow irritating discharge may come from the cervix uteri, independently of any pre-existing vaginitis. If a positive opinion as to the gonorrhœal nature of the case is required, the gonococcus must be sought for in the discharge. If there is purulent urethritis, the contagious nature of the case is satisfactorily determined, as irritating uterine discharges do not affect the urethra.

Prognosis.—If assiduously treated, so that extension to the vaginal *cul de sac* and cervix uteri is prevented, the disease has a duration of about three weeks. If neglected, it may become chronic and prove very intractable, lasting sometimes for many months; this is especially likely to be so if the disease has spread to the cervix uteri and endometrium, or to the urethra. Although many complications may arise during the progress of the disease, but few are commonly of immediate danger. The length of time that the discharge remains contagious is most uncertain. Probably any discharge, however scanty and serous it may have become, may cause disease if increased by accidental irritation.

Treatment. — In the *acute* stages of vaginitis the treatment consists in allaying irritation by rest in bed; warm baths; frequent injections of warm water, solution or boric acid, or weak astringents—such as weak solutions of acetate of lead, of alum, &c.; and the administration of saline aperients. If the pain be great, a little laudanum may be added to the warm water injections. The diet should be low, all sources of irritation should be removed, and the habits and health of the patient regulated. When the acute stage has subsided, astringent injections should be used somewhat stronger than those employed at first. The vulva should be protected from contact with the discharge by vaseline, and the labia should be separated by a piece of lint wetted with lead lotion.

In the *chronic* forms of the disease the strength of the astringent injections must be increased. The most useful are the sulphate, chloride, and sulpho-carbolate of zinc, tannic acid, and liquor carbonis detergens. In the intervals between the injections, tampons saturated with the astringent lotions may be introduced into the vagina, and alum or tannin may be applied to the deeper parts of the canal by means of the speculum. The injections must be efficiently done, after washing away the discharge with warm water, so that the whole mucous surface of the vagina, especially that of the *cul de sac*, is thoroughly laved. Astringent vaginal suppositories are also useful. If in chronic cases there are patches of erosion, similar to those met with in cases of gleet in the male, they should be mopped with a 20 per cent. solution of silver nitrate.

Internal remedies are useless unless the urethra is affected, when they have a certain value.

COMPLICATIONS.—*Vulvitis* is one of the earliest and commonest complications of gonorrhœal vaginitis. The labia, nymphæ, and clitoris are red and swollen, and secrete a copious yellow fœtid discharge. The nymphæ often project between the swollen labia, and the parts may be excoriated in consequence of destruction of the surface epithelium, and sometimes from ulceration of the mucous follicles. There is considerable pruritus. Usually, if the parts are kept clean and free from irritation, the inflammation subsides in a few days. Warm baths and sedative lotions are useful to allay the irritation, and the labia should be separated by a piece of lint kept moist with lead and opium lotion.

Urethritis is the most constant accompaniment of gonorrhœa; rarely so acute as to cause much irritation, it may produce severe suffering. It begins with itching and smarting at the meatus, which is red and swollen. A purulent or muco-purulent discharge oozes from the passage unless the patient has just micturated; even then a little discharge can be found in the mouths of the follicles which open close to the meatus. This discharge is very persistent, and is probably a source of contagion long after the disease is cured elsewhere. The treatment of urethritis consists of frequent warm baths, astringent injections, and copaiba internally. Obstinate chronic discharges may be arrested by caustic solutions, carefully applied.

Abscess of the glands of Bartholin is not uncommon in gonorrhœa. There is a painful swelling, which may attain the size and somewhat the shape of a bantam's egg, lying in the labium majus, in which fluctuation can be detected early. The abscess may not empty itself through the duct, but into the cellular tissue of the labium, where a large collection may form before it opens superficially. The treatment consists in free incision as soon as fluctuation is felt. Often a troublesome fistula is left, which, alternately closing and opening, causes fresh accumulation and fresh discharge of pus from time to time. This is best treated by free incision and drainage.

Bubo is rare in the female, but may occur when the urethra is involved.

Acute inflammation of the cervix and os uteri is a frequent consequence of gonorrhœa. The neck of the uterus is swollen, red, and often excoriated about the os, whence a copious discharge issues, at first clear and viscid, then purulent. This subsides to a thin muco-pus, and either soon ceases or more commonly passes into chronic catarrhal discharge from the glands of the cervix, which lasts an indefinite time and long retains its contagious quality. Chronic cervical and corporeal endometritis, associated with a thick viscid discharge in the former and a thinner discharge in the latter, may result from gonorrhœal infection. In the acute forms, complete rest, warm baths, with astringent applications and saline aperients, may arrest the disease. In the chronic stage the treatment is that of uterine catarrh. *See* WOMB, Diseases of.

Among the rarer and more dangerous complications of gonorrhœa in the female may be mentioned metritis, perimetritis, salpingitis, pyosalpinx, hydrosalpinx, ovaritis, and peritonitis. Pyæmic infection may occur through the vaginal veins.

Certain complications, more general in their nature, may also occur as in the male sex. Gonorrhœal rheumatism is less common in women than in men.

BERKELEY HILL. CHARLES STONHAM.

GONORRHŒAL RHEUMATISM. An affection of the joints associated with gonorrhœa. *See* RHEUMATISM, GONORRHŒAL.

GOOSE-SKIN.—A condition of the skin in which this structure is rough and wrinkled, like that of the plucked goose. It is of a transient character, being due to contraction of the muscular fibres of the skin, producing wrinkling of the integuments, and prominence of the hair-follicles—horripilation; and is observed as the result of the direct application of cold, or of a shock, and in the early stages of fevers.

GOUT (*gutta*, a drop).—SYNON.: Podagra, Chiragra, Gonagra (when the disease affects the foot, hand, or knee respectively); Fr. *Goutte*; Ger. *Gicht.* The name *gout* is supposed to have originated in the idea of the dropping of a morbid fluid into the joints, and is of very ancient date.

DEFINITION.—Gout is usually regarded as a general or constitutional disease, associated with the presence in the system of excess of uric acid, the complaint being commonly looked upon as a manifestation of the so-called *lithic* or *uric acid diathesis*, and as due to *lithæmia*. It may be hereditary or acquired; and is characterised ordinarily by a peculiar inflammation of the joints—*articular* or *regular gout*, attended with the deposit of urates, consisting almost entirely of urate of sodium, in their structures, affecting usually and especially the smaller joints, and at first more particularly the metatarso-phalangeal articulation of the great toe, but afterwards extending to other joints. Similar deposits of urate may occur in other tissues—*tophaceous gout*; and certain organs of the body are liable to become the seat of functional disorders, or of pathological changes, during the progress of the disease—*non-articular* or *irregular gout*; while it is also usually attended with general symptoms. Gout in the early part of its course is in the large majority of cases an *acute* affection, occurring in periodic attacks or 'fits'; but subsequently it tends to become more or less *chronic* and permanent, though even then generally presenting exacerbations from time to time. The gouty diathesis may, however, be present without giving rise to any joint-affection or other evident organic mischief.

Ætiology. — There are certain definite points which require consideration under this heading.

1. It will be expedient at the outset to discuss the circumstances under which the gouty diathesis is developed, and to point out the more obvious *causes* with which this condition is associated. Ætiologically, cases of gout may be practically arranged into three main groups, according as the disease arises from—(*a*) *Hereditary transmission*. (*b*) Certain errors in regard to *food* and *drink*; often associated with *deficient exercise*. (*c*) Impregnation of the system with *lead*. In not a few instances, however, it must be remembered that these causes are more or less combined.

(*a*) *Hereditary transmission*. Gout is one of the most striking examples of an hereditary disease, and, once established, it may be transmitted through several generations, even when every endeavour is made to eradicate it; but as the malady is, as a rule, more or less intensified by pernicious habits, it becomes in most cases a permanent legacy. Sir Alfred Garrod found that in more than half his cases hereditary taint could be distinctly traced; and the proportion is much greater among the upper classes. It sometimes happens that when gout becomes developed *de novo* in an individual, children born previously are free from the complaint, while those born subsequently are affected. Gout appears to be more readily transmitted by the female than the male line. According to Hutchinson, the diathesis becomes stronger in the parent with advancing years, and consequently the disease shows itself with greater frequency, and in more marked form, in the younger than in the older members of a gouty family. Hereditary influence may be so powerful that the complaint arises without any other obvious cause; but most commonly it is aided by more or less indulgence in certain injurious habits to be presently mentioned. Gout sometimes exemplifies the so-called 'law of atavism,' which is usually due to the fact that in the generation free from the complaint every precaution is taken to avoid causes which tend to originate a gouty paroxysm. It has been affirmed, however, that this 'missing a generation' only applies to the transmission from a grandfather through his daughter to the grandson. The hereditary nature of gout is shown not infrequently in the age at which the disease reveals itself. Should the predisposition be powerful, the complaint may appear in very early life; and the younger the subject who is attacked, the more likely is there to be an hereditary taint. Hutchinson is of opinion that many obscure joint-affections in young persons are due to hereditary gout.

(*b*) *Errors relating to food, drink, and exercise*. In a considerable number of cases gout is originated *de novo*, in consequence of certain errors affecting the diet and habits; or an inherited tendency to the disease is thus considerably aggravated. In general terms these errors may be summed up as excessive eating, especially of particular articles of food; undue indulgence in alcoholic drinks; and indolent habits, with deficient exercise. They are frequently associated in the production of gout in individual instances.

The gouty diathesis is chiefly promoted by foods which are rich in nitrogen, and especially meat. Beef is believed by many to be particularly baneful. Undue consumption of sugar and starchy foods has also been regarded as aiding materially in the development of gout. Many articles of diet, either from their inherent nature or from the manner in which they are cooked, may help in the production of the complaint, by giving rise to digestive disorders.

The relation of intemperance in the use of alcoholic drinks to the gouty diathesis is highly important, and is abundantly proved by everyday experience, notwithstanding the attempts made by certain self-constituted 'authorities' on gout to cast a doubt upon this fact. The more potent wines have the greatest influence, and port wine has proverbially been regarded as the most injurious of all. Champagne, burgundy, madeira, sherry, and marsala are also undoubtedly capable of developing or aggravating gout. Hock, sauterne, moselle, and light claret seem to be least injurious; but even these, if indulged in to excess, may in course of time set up, or, at any rate, intensify the gouty diathesis. Strong malt liquors stand next to wines as originators of gout. Spirits are comparatively feeble in their power of producing the disease, and this is the explanation usually given of its infrequency in those countries or districts where this class of drinks are chiefly used, such as Scotland and Newcastle-on-Tyne, where whisky is the common beverage. Rum is said to form an exception to this statement. Cider and perry may unquestionably set up gout, if taken to excess, especially when sweet and not properly fermented. Excessive indulgence in a mixture of alcoholic drinks is probably more deleterious than if one is adhered to. The quality of wines has much to do with their tendency to induce gout. Factitious wines and others of inferior quality, as well as those which are very sweet, or which contain much tannin, are most liable to produce this complaint. Drinks which cause a marked diuretic action are less injurious than those which have but little action of this kind.

Deficient exercise undoubtedly promotes the development of gout in many cases. Persons who follow sedentary occupations, or who live indolent and lazy lives, are most liable to the disease; and not a few become gouty because improvement in their circumstances enables them to 'keep a carriage,' and they are thus deprived of the exercise which they were previously accustomed to take.

(*c*) Another group of cases of gout are those which occur in connexion with *impregnation of the system with lead.* Sir Alfred Garrod found among his hospital patients that 33 per cent. of those suffering from gout had been subjected to the influence of lead in their various occupations; and the association is now generally acknowledged. This metal does not appear, however, to originate the gouty diathesis, unless aided by more or less indulgence in alcoholic drinks, though the amount of the latter consumed is usually far less than would alone account for the condition. Gouty persons are remarkably susceptible to the influence of lead; and when this metal is given to such subjects for medicinal purposes, it is very liable to bring on a severe attack of acute gout.

It is important to note here that, according to Dr. Thomas Oliver, of Newcastle-on-Tyne (*Goulstonian Lectures*, 1891), this intimate relation between gout and saturnine poisoning is not seen in the north. 'Workmen from the south develop it in the north of England. The natives of the north, though equally exposed, seldom become gouty even when the kidneys are affected.' This authority does not regard the difference in the drinking habits of the people as the explanation of the difference, but thinks it is probably the result of external conditions, though he cannot explain it.

2. *Predisposing causes.*—Beginning with *age*, distinct gouty attacks in a large majority of cases make their first appearance in persons between thirty and thirty-five or forty years old. Those which occur under thirty are, with few exceptions, more or less hereditary. Well-marked gout is exceedingly rare under twenty, but it may occur in younger subjects, probably even in children. Dr. Lorimer, of Buxton, found that saturnine gout appears at an earlier age than non-saturnine. The complaint is usually declared before fifty, and becomes progressively less frequent in its manifestation for the first time after this period of life. It is quite exceptional for gout to commence after sixty-five, but it may begin even in extreme old age. With regard to *sex*, males are far more commonly the subjects of well-marked gout than females. This is mainly accounted for by the difference in the habits of the two sexes. It has also been partly attributed to the occurrence of menstruation in females, which is supposed to act as a safeguard, and in these subjects gout generally appears after the cessation of this function. When strongly hereditary, gout may, however, develop even in young females, of which the writer has seen some well-marked examples.

Bodily conformation and *temperament* have been credited with a predisposing influence in relation to gout, persons of a sanguine temperament, and of corpulent, plethoric habit of body, being supposed to be most subject to this disease, and to have it in its most acute form. These conditions are often produced by the very habits which originate gout, and certainly persons who are gouty by inheritance often do not present any of these characteristics, while those exhibiting marked contrasts in appearance and temperament seem to be equally the subjects of the complaint. It is not uncommon in individuals of a nervous temperament, thin and wiry in frame, and they are said to be more subject to the irregular and asthenic forms of the disease. *Social position* and *occupation* materially influence the occurrence of gout. Formerly the complaint was met with almost entirely among the higher classes, and it was looked upon as an aristocratic disease. Now, however, it is common enough among the middle classes, chiefly those who are in affluent circumstances; while it is very prevalent amongst those following certain occupations, such as butlers, coachmen, butchers, publicans and barmen, coal-heavers, porters, hair-cutters, and painters or others who have to do with lead. Conditions which involve excessive mental labour and fatigue, prolonged worry or anxiety, and other effects which exhaust and depress the nervous system, seem to predispose to gout. Sir Dyce Duckworth is of opinion that *sexual indulgence* in early life, by its generally enervating influence, is potent, not only in causing early and severe attacks of gout, but also in the premature induction of gouty cachexia. As regards *climate*, those climates which are cold or temperate, and especially at the same time damp and changeable, present by far the greatest number of cases of gout, and in most tropical countries this complaint is unknown. In the south of Europe it is far less frequent than here. Gout is much more prevalent in England than in Scotland or Ireland; though it is uncommon in the north of England.

3. *Causes of a gouty fit.*—An acute paroxysm of gout may come on without any evident *exciting cause* whatever, especially if the disease is strongly hereditary, or has been long established. Under these circumstances outbreaks of the complaint seem to become habitual at certain seasons, or they arise from very slight causes, which are less and less obvious as the case progresses. Often, however, some distinct exciting cause can be made out, affecting the digestive organs, the vascular or nervous systems, or the functions of the skin or kidneys, or disturbing the system in other ways. The most important are eating or drinking too much, either on some particular occasion, or habitually for a longer or shorter period, until at last a fit of gout terminates the indulgence; indigestible articles of food; neglect of the act of defæcation, or prolonged constipation; undue physical work or exertion; exposure to cold or wet, or sudden suppression of perspiration; excessive mental work, worry, or anxiety; emotional causes, sudden, powerful, or depressing, such as joy, a fit of rage, fright, or deep grief; sexual indulgence or excess; hæmorrhage, acute illness, or other like debilitating causes; and injury. The indiscriminate use of certain medicines, such as preparations of lead or iron, may excite a gouty paroxysm. The implication of a particular joint may be due to a strain or injury, which may be very slight, such as the pressure of a tight boot, or the toe being trodden upon. Injury to the knee has caused that articulation to be first affected. As *predisposing causes* of acute gouty attacks, climate and season are highly important. Undoubtedly gouty paroxysms may often be averted by residence in a warm climate, either permanently or during the colder seasons of the year. Early attacks are most frequent in late winter or spring, and the first paroxysm occurs especially towards the end of January or beginning of February. Afterwards a fit of gout takes place also in the autumn; and subsequently the intervals become shorter and more irregular. One seizure predisposes to another, and the peculiar tendency to recurrence in gout is increased with each succeeding paroxysm. The occupation of an individual may predispose to the occurrence of gout in particular joints; thus butlers have it in the feet, coachmen and washerwomen in the hands.

Pathology.—The pathology of gout is still in a very unsettled state. With some authorities it is a comparatively simple matter, while others regard the complaint as a highly complex condition, having wide relationships in diverse directions within the system. It will be impossible within the limits of this article to do more than bring out the main facts bearing upon the subject, and to indicate the chief theories founded thereon.

1. Gout is by the large majority of writers referred to the general or constitutional group of diseases, and it is customary to speak of the *gouty diathesis* or *dyscrasia*, of which the local changes are but a manifestation. Further, it is believed by most authorities that a person may be truly gouty, and yet be free from any of the special lesions usually associated with the condition. According to Hutchinson, Charcot, Duckworth, and others, there exists a 'basic arthritic diathesis,' upon which may be built up, under the influence of special causes, a tendency to gout, rheumatism, or their various modifications and combinations.

At the present day it is almost universally admitted that gout has an intimate relation with the presence of *lithic* or *uric acid* in the system, which is generally regarded as the morbific agent or 'peccant matter.' As Duckworth expresses it—'No uric acid, no gout.' To Sir Alfred Garrod we are indebted for having clearly and positively demonstrated this relationship. In its pronounced form gout is characterised by the deposit of urate of sodium in connexion with the joints and other structures, which distinguishes it from all other complaints. Dr. Haig has recently revived the view that there is no real distinction between the rheumatic, gouty, and rheumatoid forms of arthritis, but that they are all due to uric acid. This question need not, however, be discussed here.

Assuming the essential relationship between gout and lithic acid to be established, beyond this point there is much diversity of opinion. Many adopt a simple *humoral* theory, attributing the disorder to excess of this acid in the blood and tissues. Some, however, do not so much regard the quantity of acid, as the conditions under which it exists, and its insolubility. Gout is often spoken of as a mere manifestation of the *lithic* or *uric acid diathesis*, and the condition of the blood containing excess of the acid was termed *lithæmia* by the late Dr. Murchison. Sir William Roberts[1] has proposed the term *uratosis* as distinguished from lithæmia, to designate the 'precipitation of the crystal urates in the tissues or fluids of the body.' He draws attention to the fact that 'lithæmia is only an exaggeration of a normal condition, for traces of uric acid always exist in healthy blood; but uratosis, even in the minutest degree, is pathological.' He is of opinion that there are different kinds of uratosis, and would thus speak of *gouty uratosis* and *saturnine uratosis*, believing that the gouty diathesis and plumbism are radically distinct, differing in all respects except in their tendency to uratic deposits. He further considers it quite possible that precipitation of the crystalline urates may occur not only in the form of coarse masses, but also in the form of minute stars or detached crystals, which can only be detected with the microscope; and that this 'microscopic uratosis,' either in the substance of organs or in the blood itself, may account for the visceral neuroses, thrombosis and embolism, and the occasional sudden death, which are encountered in gout, and may explain some very obscure incidents in its history.

---

[1] *Med. Soc. Trans.* vol. xiv. p. 84.

Uric acid exists in the blood and in the fluid that diffuses therefrom mainly as a salt of sodium, but whether the combination be a quadriurate or a biurate, or a mixture of the two, or sometimes one and sometimes the other, is not known. The quadriurates are highly soluble in blood-serum, and cannot be thrown down therein in the crystalline state, while the biurates are very sparingly soluble in that medium, and are readily thrown down in it in a crystalline form (W. Roberts). The acid is being constantly formed in the system in connexion with the processes of nutrition and metabolism, but under ordinary circumstances it is either destroyed or is eliminated by the kidneys, so that it is kept within normal limits. According to Garrod, the final stage is the production of urate of ammonium in the kidneys.

We may now proceed to consider the main views held to explain more immediately the lithæmic condition, or the accumulation of uric acid in the tissues. They may be summarised as follows:—(*a*) *Excessive formation.* It certainly appears reasonable to suppose that certain of the recognised causes of gout must lead to an absolute increase in the amount of uric acid formed in the system. Ebstein is of opinion that in the gouty this acid forms in perverse localities, as in muscles and the marrow of bones. (*b*) *Undue retention.* Imperfect excretion or elimination of uric acid, leading to its retention in the body, can never be overlooked as an important factor in relation to the gouty condition. According to Garrod, such retention is due to defective action of the kidneys, either temporary or permanent, and when these organs are in a state of advanced organic disease, their excretory functions must obviously be interfered with considerably. Sir William Roberts thinks it probable that the defective power of the kidneys to eliminate uric acid is due to diminished alkalescence of the blood, which renders it less soluble. He has found that if sodic quadriurate lingers too long in the blood it becomes converted into a biurate, and when the accumulation of this salt has reached a certain point of saturation, it is suddenly precipitated as a crystalline deposit in the joints or elsewhere. Dr. Ralfe is of opinion that the first step in the production of gout is diminished alkalinity of the blood, by reason of the accumulation in it of acid and acid-salts; and that retention in the system is due to a fault in the tissues, leading to incomplete elimination. Haig, as the outcome of his extensive researches relating to uric acid, strongly supports the view that excess of this acid in the blood and system is generally due to retention, and that this is the result of deficient alkalinity of the blood, which leads to gradual accumulation of the acid in certain parts; he would thus explain all the phenomena of the gouty state. According to Garrod, with whom Haig agrees, it appears that uric acid is attracted in different degrees by different structures, and tends to be held back by, and accumulate in the liver and spleen, and in fibrous tissues, especially those of the joints, probably because these structures are acid, or less alkaline than the rest of the tissues and fluids of the body. (*c*) *Imperfect reduction.* According to this view, it is supposed that the normal process, by which uric acid is changed in the blood and certain organs into other substances more soluble and less noxious, fails, or is imperfectly carried on, and thus it accumulates in the system. It used to be believed that uric acid was converted into urea, but more recent investigations are opposed to this idea. (*d*) *Special views.* It will be convenient under this heading to mention certain individual opinions with regard to the pathological relations of uric acid and gout. The late Dr. Murchison regarded gout as a mere result or variety of lithæmia, and attributed this condition to imperfect digestion, and more especially to 'functional derangement of the liver.' He brought forward facts to show that the healthy liver plays an important, and perhaps the principal, part in carrying on those chemical changes by which albuminous substances are disintegrated in the body, which normally result in the production of urea. If this process is persistently deranged, lithic acid, a less oxidised body, is formed. Professor Latham also advocates the hepatic origin of gout, but considers that 'imperfect metabolism of glycocine is the primary and essential defect.' Dr. Ord regards gout as arising from a tendency to a special form of degeneration, or want of tissue organisation in some of the fibroid tissues, with excessive formation of urate of sodium, which is discharged into the blood, and deposited in parts least freely supplied with vascular and lymphatic structures. According to Ebstein, the primary factor in gout is nutritive tissue-disturbance, a necrotic change taking place in the affected structures, which is followed by deposit of urates.

Such are the principal facts and theories bearing upon the relations of uric acid to gout. It must be mentioned that some eminent writers have disputed this close relationship, but it would not serve any practical purpose in this article to discuss the various hypotheses which have been advanced in the endeavour to explain the nature and origin of gout.

One important point remains to be noticed, and that is the relation of the *nervous system* to gout. Other writers on the subject have maintained that such a connexion exists, but Sir Dyce Duckworth[1] has developed this idea more fully, and has brought forward much evidence in favour of the view that gout is a *neuro-humoral* disease. He recognises a *gouty neurosis*, which may be primary or central, or secondary or induced; and maintains that there is a functional disorder of a definite tract of the nervous system, which he is inclined to localise in some part of the medulla oblongata, but does not insist on this point. He further believes 'that this diathetic neurosis imposes its type upon the affected individual in definite nutritional modes, affecting the assimilating and excreting powers, exhibiting marked peculiarities in nervous impressibility, and determining, in a more or less degree, a physiognomy of the gouty.' This authority recognises the dependence of many gouty phenomena upon 'perverted relations of uric acid and sodium salts in the economy' which result from the morbid peculiarities just mentioned. He considers that in primary or inherited gout, the toxæmia is dependent on the gouty neurosis, of which it is a secondary manifestation; while in secondary or acquired gout, if, together with toxæmia induced by certain habits, distinctly depressing and exhausting agencies, affecting the nervous system, come into operation, the special neurotic manifestations of the gouty diathesis will occur, and be impressed more or less deeply upon the individual and his offspring.

Space will not permit the discussion of the modes in which the several causes which produce the gouty condition or its local manifestations individually act. In general terms, it may be stated that they produce their effects chiefly by increasing the amount of uric acid formed, or interfering with its elimination; disordering digestion and the hepatic functions; increasing the acidity of the blood and tissues; affecting tissue-change and metabolism; influencing the circulation; or producing some change in the nervous system.

2. We have thus far been concerned mainly with the pathology of the gouty diathesis, and it remains to offer a few remarks with regard to its *local manifestations*, and more especially to the occurrence of acute attacks of gout, and the formation of uratic deposits. According to the lithæmic theory, any cause which tends suddenly or rapidly to increase the amount of uric acid in the blood in a gouty individual may lead to acute articular gout, or some other obvious manifestation of the disease. Dr. Haig would attribute the joint-affection to conditions increasing the acidity of the blood, and thus driving the uric acid into the joints, the structures of which are less alkaline than other tissues. Others call in the aid of the nervous system to explain the phenomena. As regards the gouty inflammation, this is often looked upon as the result of the irritant action of the urate, and Garrod affirms that even after the first attack a deposit of this substance is found. Another idea is that the acute paroxysm is the consequence of an attempt on the part of the articular structures to destroy and eliminate the urates accumulated in connexion with them. The tendency to implication of joints and allied structures seems unquestionably to depend to a great extent upon their slight vascularity, and this especially applies to the smaller joints, which are chiefly affected in gout, and which are also distant from the centre of the circulation, so that the blood passes through them in a feeble and languid stream. They are, further, much exposed to the direct influence of cold, and are very liable to slight injury or strain, whereby their nutrition is affected, which predisposes them to the gouty change. The metatarso-phalangeal joint of the great toe is subjected to much pressure, and also to sudden shocks (Garrod).

It is an undoubted and well-known fact that marked gouty changes, with uratic deposits in the joints and elsewhere, may develop without any definite acute attacks; and as gout advances in a particular case, the deposit often becomes very abundant, while the paroxysms progressively diminish in intensity. Some writers think that true gouty lesions may occur, and yet without any formation of urates.

The opinion is held by many authorities that uratic deposits only take place in structures the nutrition of which is impaired, and which have already begun to degenerate. As already stated, Ebstein maintains that a nutritive disturbance of the affected tissue is the primary change, leading ultimately to its necrosis, and that uratic crystallisation is secondary, not occurring before complete death of the damaged texture. He looks upon sodium urate as a directly poisonous irritant wherever deposited, the injurious effects varying according to the quantity and concentration of the deposit, and the vulnerability of the special tissue involved, firm textures resisting better than those of looser character. He regards the incrustation as analogous to calcification; and believes that lime-salts may be subsequently deposited in gouty tissues.

Anatomical Characters.—In its most typical manifestations gout is characterised anatomically by the occurrence of a peculiar form of inflammation affecting certain joints, attended with the deposit of urate in connexion with their structures. Taking an individual articulation, this is at first usually the seat of an acute inflammatory process, indicated by the usual signs of increased vascularity and redness, tumefaction, and serous effusion into the interior of the joint, as well as into the surrounding tissues. The results of *post-mortem* examinations show that even in the very earliest period a deposit of urate takes place; and as the attacks become repeated again and again, the signs of inflammation become less and less prominent, while the deposit increases, until at last it may form considerable masses, and infiltrate extensively all the structures entering into the formation of the articulation. The joint then becomes permanently enlarged and distorted, while the ligaments are thickened and more or less stiff or even quite rigid, until ultimately complete ankylosis may be produced. The deposit seems to commence in the substance of the cartilage covering the ends of the bones, starting near its superficial or free surface, and gradually extending more deeply, though for a time a thin layer of cartilage lies between it and the cavity of the joint. This deposit at first forms a whitish opacity, but as it becomes more abundant it encrusts the cartilages, and also the inner surface of the ligaments, and the surfaces of fibro-cartilages where these exist. More or less extensive spots or patches become in time distinctly visible, and even the entire surfaces of the bones forming a joint may be covered with a chalky-looking substance. 'The appearance of articular cartilage in which simple deposit of urates has taken place exactly resembles that which would result from smearing or splashing the surface with fresh white paint' (Duckworth). The synovial membrane may also present white points, but the synovial fringes at their margins seem to escape, on account of their vascularity. In the larger articulations the synovial fluid may be thickened, and may even contain separate crystals or tufts of the urate. Subsequently the ligaments and adjoining structures are infiltrated, and it is to this cause that the stiffness or rigidity of gouty joints is mainly due. Distinct masses of deposit may, however, form, which also interfere with movement. They are known as *tophi* or *chalk-stones.* In course of time the tissues covering a gouty joint may be destroyed, including the skin, the chalky-looking substance being thus exposed, and unhealthy suppuration and ulceration set up, or even gangrene. Very rarely suppuration takes place in a gouty joint itself, or hæmorrhage may occur.

---

[1] *A Treatise on Gout*, 1889.

The opaque white substance characteristic of articular gout is found on microscopic examination to consist of fine crystals, in the form of needles or prisms. They are chiefly arranged in minute clusters, radiating from a centre; and in the cartilages they form a more or less compact network. Chemical examination shows that they are usually composed almost entirely of urate of sodium.

The metatarso-phalangeal articulation of the great toe is the one primarily attacked in the large majority of cases of gout; and this joint, on one or both sides, may alone present any change. As usually seen, however, the disease has progressively involved many joints. In the feet it may implicate all the articulations, but it is a curious fact that the tarso-metatarsal and the phalangeal joints of the great toe generally escape, or are but little affected. Similarly, all the joints of the hands and fingers are often involved, but the metacarpo-phalangeal joint of the forefinger is one of the most commonly attacked. The gouty change not uncommonly extends to the larger joints, more especially those of the leg, but the shoulder and hip-joints are very rarely implicated. In exceptional cases other articulations are found involved, such as the temporo-maxillary, those of the spinal column, of the pelvis, or even of the larynx in rare instances.

Coming now to other structures, deposits of urate may occur in various parts of the body, sometimes abundant and widely spread, in connexion with bursæ, tendons and aponeuroses, sheaths or the substance of muscles, the sclerotic coat of the eye, the cartilages of the external ear, eyelids, nose, or larynx, under the skin, or rarely in the cerebral and spinal meninges. Urates have also been found in concretions on the aortic and mitral valves, and in plates from the arch of the aorta. More or less serous effusion may be present in bursæ which are the seat of uratic deposits. The exact composition of these tophi varies, and they may contain calcium urate, oxalate, or phosphate, as well as sodium chloride and animal matter, in addition to sodium urate.

As regards bone, the periosteum is often affected, and some writers have described a deposit of urate in bone itself; but Garrod has not found evidence of its having originated in this tissue. He considers that the periosteal formations sometimes acquire sufficient size to press on the osseous tissue, and to cause its absorption.

The condition of the *kidneys* associated with gout is of great importance, and these organs probably begin to be affected at a very early period in the history of a case, for they may be found distinctly diseased when there have been little or no external manifestations of the complaint. In the first instance a deposit of sodium urate takes place, probably within the renal tubuli, which afterwards involves their walls and penetrates to the intertubular tissue. This is seen in the form of white streaks in the course of the tubuli, and of white points at the extremities of the papillæ. The deposit goes on increasing, and a chronic inflammatory process is set up, ending ultimately in the production of a variety of 'granular contracted kidney,' known as the 'gouty kidney' (*see* Bright's Disease). Other morbid states in connexion with the urinary organs observed in some cases of gout are the presence of calculi consisting of uric acid, urates, or oxalate of calcium; chronic cystitis; or urethritis.

It must again be noted here that many writers recognise degeneration of the involved structures as an essential part of the gouty change, and appearances characteristic of such degeneration have been described in different tissues; thus the cartilages are said to be generally fibrillated and eroded before the deposit of urates takes place.

In the course of gout other morbid changes often arise, affecting different structures and organs, and either occurring as acute or even fatal events, or being of a chronic nature. Only the more prominent of these can be mentioned here, and they mainly include changes in the pharyngeal structures; congestion, catarrh, or more serious inflammation of some part of the alimentary canal; congestion or catarrh of the air-passages, chronic bronchitis, emphysema, and, some think, pneumonia; fatty disease of the liver, and perhaps cirrhosis; meningitis, neuritis, cerebral hæmorrhage; cardiac changes, including chronic valvulitis and degeneration of the valves, and hypertrophy, followed by degeneration of the cardiac walls; atheromatous changes in the vessels, hypertrophy of the muscular coat of the small arteries, or arterio-capillary fibrosis; various diseases of the skin, such as erythema, urticaria, eczema, psoriasis, as well as changes in the nails; iritis, hæmorrhagic retinitis, and other conditions of the eyes; and affections of the ear. How far some of these conditions can be directly attributed to the gouty diathesis, or are merely the result of the same causes which have induced this diathesis, may be fairly disputed. It is worthy of remark that acute inflammation in connexion with the heart is not met with in cases of gout, and this has been attributed to the great vascularity of the endocardium and other cardiac tissues, for which consequently the urate has no affinity, or it is destroyed in its passage through them.

The condition of the blood in gout may be here noticed. In early cases the chief deviation from the healthy state presented by this fluid is that during the acute paroxysms the serum contains a distinct excess of uric acid, in the form of a salt of sodium; and this can be obtained in appreciable quantity, even in a crystalline form. In the intervals the blood is quite normal. When the gouty condition becomes chronic, the excess of uric acid is constant; and oxalic acid can also be frequently detected. In course of time the serum becomes lowered in its specific gravity, its albumen is deficient, and its reaction is less alkaline, in extreme cases becoming almost neutral, owing to the presence of excess of acids. The red corpuscles often diminish in number, and the blood deteriorates in quality as a whole in many cases of chronic gout.

Uric acid has been obtained from the fluid contained in the blebs produced by blisters; from inflammatory serous effusions; from dropsical accumulations, such as ascites; and from the subarachnoid fluid.

Clinical History and Symptoms.—The clinical history of gout is a very varied one, and the symptoms observed in different cases which are regarded as of a gouty nature are exceedingly numerous and diverse. Whether they are always directly due to uric acid in the system is, to say the least, a matter of considerable doubt. The habits which generate gout often give rise to symptoms, and even to definite morbid changes, which cannot justly be looked upon as part of this complaint. Again, the custom which some practitioners adopt, of looking upon every acute illness, particularly inflammation of organs, occurring in gouty subjects, as being due to the lithæmic condition, and of a special nature, and applying the term 'gouty' to all such complaints, is certainly going too far, though it may be acknowledged that gout does often modify their clinical history. It is not easy within a limited space to give even a sketch of the various clinical phases of gout, but before considering the symptoms in detail it may be well to indicate their general nature. 1. In its typical form gout is attended with acute symptoms referable to certain joints, and these tend to recur at intervals, constituting 'fits of gout,' the intervening periods becoming shorter and shorter as the case progresses—*acute articular* or *regular gout*. 2. These attacks culminate in obvious chronic changes in the affected joints—*chronic articular gout*—but even then more or less acute paroxysms are liable to arise from time to time. 3. In connexion with the acute attacks, and sometimes preceding them, *general* or *constitutional* symptoms are usually observed; and symptoms belonging to this class become permanent in most cases of chronic gout. 4. When gout affects other organs and structures besides the joints, corresponding symptoms are developed, according to the part implicated. In general terms these are variously grouped as cases of *non-articular*, *irregular*, *misplaced*, *latent*, *masked*, or *anomalous gout*; and when such symptoms are acute in their character, affecting some internal organ, and coming on during the course of an attack of acute articular gout, the joint-symptoms at the same time subsiding, this constitutes what is termed *retrocedent gout*. The symptoms which may occur in these cases are conveniently subdivided as follows:—(*a*) Those indicating more or less functional disorder of certain organs, varying much in intensity, and either being constantly present, or only coming on at intervals. (*b*) Those due to acute inflammatory affections of organs. (*c*) Those resulting from the chronic structural changes in tissues and organs induced by gout, and from the deposit of urates in different parts. Having given this outline, we may now discuss the symptoms of gout in some detail, but it will be convenient in doing so to adopt a rather different arrangement from that just sketched.

1. **Premonitory Symptoms.**—There are certain symptoms, of a somewhat indefinite character, and not of any marked intensity, which are often met with in gouty subjects, or even in persons who have never actually suffered from declared gout, but which seem to be distinctly associated with the complaint. These may be regarded as *premonitory symptoms*, for they frequently give warning that the gouty condition is in process of development, and, if duly recognised, enable the patient so to regulate his mode of living as to ward off the disease. Indeed, it will be found on careful inquiry that gouty phenomena, which may be very marked, are commonly noticed from time to time before the first actual fit of gout occurs, and there may even be suspicious twinges or uncomfortable sensations about the toes or fingers now and then. In a large number of cases, however, no definite premonitory symptoms immediately precede the first gouty paroxysm; but in connexion with subsequent paroxysms prodromata are usually marked, so that confirmed gouty patients can predict when an attack is imminent. As to the nature of these symptoms, they vary in different persons, and this may depend upon individual predisposition. The most obvious are digestive and hepatic disorders, attended with marked flatulence and eructations, heartburn, acidity, and constipation or diarrhœa, with unhealthy stools, the tongue being often large, flabby, and much furred; palpitation or uncomfortable sensations about the heart; catarrh of the throat and respiratory passages, violent fits of sneezing, or asthmatic attacks; derangements of the nervous and muscular systems, indicated by a liability to headache, giddiness, attacks of migraine, noises in the ears, disorders of vision, marked irritability of temper and fretfulness or lowness of spirits, languor, impairment of mental vigour and intellectual hebetude, heaviness or drowsiness, sleep, however, being restless, disturbed, and attended with unpleasant dreams, peculiar grinding of the teeth, sometimes associated with somnambulism, numbness or tingling in the limbs, especially in the fingers or toes, neuralgia or neuritis in various parts, twitchings, startings in the limbs, muscular cramps, especially in the calves of the legs, or possibly even convulsions, lumbago and other forms of muscular rheumatism; profuse perspirations; certain skin-affections; and changes in the urine. This excretion usually tends to become high-coloured and deficient, and to deposit lithates abundantly, or even lithic acid crystals, though at the same time the quantity of this acid eliminated within the twenty-four hours is below the normal. In advanced cases of gout, however, the urine presents very different characters from those just stated, as will be hereafter pointed out, and when habitually depositing urates it may become pale, watery, and clear immediately before an acute attack supervenes. Some patients are warned of the approach of a gouty fit by feeling unusually well, both physically and mentally.

2. **Acute Articular Gout.**—The first acute fit of gout comes on as a rule during the night, usually between 2 and 5 A.M. The patient is disturbed out of his sleep by uneasiness or pain, generally referred to the ball of the great toe on one side, and the joint is found to be inflamed, the inflammation increasing in intensity, until it usually becomes extremely severe. In some instances the corresponding joints on both sides are attacked simultaneously, in rapid succession, or alternately. Although, however, in the majority of cases gout first attacks the metatarso-phalangeal articulation of the great toe, it must not be forgotten that it may start in any of the smaller joints of the foot or hand, or even in the middle-sized joints, especially the knee or ankle. It has been affirmed that, next to the great toe, the metacarpo-phalangeal joint of the index-finger is most liable to be first attacked. Exceptional cases have come under the writer's notice, which there was every reason to believe were of a gouty nature, and in which the disease implicated several joints at a very early period of its course, the feet, however, being free.

Proceeding now to notice the clinical characters of the joint-affection, severity of the pain is certainly a striking feature in the majority of cases of acute gout, especially in early attacks. When the foot is affected, any attempt to stand causes much suffering from the first, and the pain speedily increases, until it becomes very intense, or almost unbearable. It is described in different cases as burning, throbbing, aching, tearing, plunging, boring, piercing, &c. The pain prevents sleep during the night, but towards morning it tends to diminish, and during the day there is usually comparative ease, an exacerbation again taking place as evening approaches, which goes on increasing towards night. Tenderness is very marked, and is often so exquisite that the patient dreads to be touched, and cannot bear the least movement or jarring of the affected part, or sometimes even the weight of the bedclothes, or the slightest shaking of the room. The objective signs of inflammation in connexion with a gouty joint also soon become very prominent as a rule. These are marked redness, which may be very deep and sometimes tends to lividity, while the veins are often enlarged and turgid; considerable local heat, as revealed to the touch and the clinical thermometer; and much swelling, the skin covering the part assuming a tense and shining appearance. When several joints in the foot or hand are affected, diffused redness and swelling are noticed. The tumefaction is due to effusion not only into the interior of the articulation, but also into the surrounding tissues, subcutaneous œdema being a marked feature in connexion with gouty inflammation. This can be better appreciated when the acute symptoms subside, so that pressure can be borne, which shows the pitting characteristic of œdema, and this may hold on for some time. However intense the objective signs of inflammation may be, it is an extremely rare event for acute gout to end in suppuration. As they subside, marked desquamation of the skin usually takes place. As the swelling increases, the subjective sensations generally diminish in severity; but during the progress towards recovery, intense itching is apt to supervene.

An acute attack of gout is almost always attended with more or less *general* symptoms; but it is an important fact that their severity depends upon the extent and intensity of the local manifestations of the disease, and upon the accompanying symptoms. Chills or even actual rigors may be felt at the outset, followed by febrile phenomena, sometimes slight, in other cases marked, the pyrexia being as a rule strictly secondary or symptomatic. The skin feels hot, and usually perspires, but not profusely; the temperature is moderately raised, presenting no definite variations, though marked remissions are generally observed towards morning; the pulse is increased in frequency; and the digestive organs are much disordered, as evidenced by anorexia, thirst, thickly furred tongue, offensive breath, and constipation. The urine is generally deficient in quantity, and may be very scanty, high-coloured, and concentrated; its acidity is increased; and on standing, an abundant deposit of amorphous lithates often forms, varying in colour according to circumstances, being pale-buff, yellowish-red, dark or brick-red, or intense pink if the fever is high. The relative quantity of uric acid in a particular specimen of urine is often increased, but the absolute amount discharged within the twenty-four hours is much diminished. The patient is usually exceedingly restless, and cannot lie with comfort in any position; sleep is much disturbed or altogether prevented; and cramps of the calves of the legs or of other muscles may still further aggravate the suffering. All these symptoms tend to increase the constitutional disorder. The temper is generally very irritable, or may even be violent.

The duration of the first fit of gout varies according to its severity and other circumstances. It usually ranges from four or five days to a week or ten days, but may last two or three weeks or more, there being then commonly intermissions or remissions, and several joints being involved in succession. The termination of the gouty paroxysm may be attended with critical phenomena, such as free perspiration, diarrhœa, or a very abundant discharge of urates. After the attack the patient may not recover his former state of health for some time; but not uncommonly he feels better than before, and as if the system had got rid of some deleterious element. As a rule, the affected joints are apparently quite restored after early attacks of gout; but more or less stiffness or even deformity may remain. Œdema may also persist for a considerable time, especially if the inflammatory condition has been prolonged.

One of the characteristic features of gout is the tendency which it exhibits to recurrence in its acute form. This may not happen if the patient is sufficiently careful, but such an event is rare. The rule is for the attacks to be repeated, and to recur with increasing frequency. In not a few instances the second fit does not occur until an interval of two or three years or more has elapsed, but in most this is not prolonged beyond a year. The same interval may be noticed between the next few paroxysms, but as the disease progresses they return twice a year, then more frequently, and at last become more or less constant. At the same time the mischief extends as regards the joints. It may be limited to the great toe for some time, but in successive fits spreads to the other articulations of the foot, to the hands, the ankles and knees, the wrists and elbows, very rarely to the hips and shoulders. In short, gout tends in time to involve nearly all the joints indiscriminately, and several may be implicated during a fit. Moreover, those articulations which are repeatedly attacked become more and more disabled and deformed. The symptoms in connexion with a particular joint tend to diminish in intensity the more often it is affected. As additional articulations become involved, however, the general symptoms often increase in severity, and the patient does not recover in the intervals. The duration of the attacks becomes longer as their frequency increases. The rapidity of the progress of gout is very different in different cases; and the time taken to produce permanent mischief in the joints varies considerably.

It must be borne in mind that considerable variations in the intensity and exact characters of the symptoms of acute gout are observed in individual cases. In feeble persons the subjective and objective symptoms may be comparatively slight, the inflammation assuming an asthenic character, but then the ultimate effects upon the joints are often much worse. In some instances gout develops very insidiously, without any evident acute attacks. The pain in connexion with a particular joint depends considerably on its structure, being usually much more marked if its ligaments, or the parts around, are rigid and unyielding. Previous injury or disease affecting a joint may likewise modify the symptoms. Some individuals suffer much more than others, being more susceptible to painful impressions.

3. **Chronic Articular Gout.**—In course of time more and more of the joints become permanently and obviously changed, and prevented from fulfilling their functions properly, so that a condition of chronic articular gout is established, exacerbations still occurring, however, from time to time. The permanent changes are indicated by the articulations becoming enlarged, deformed, and irregular in shape, often presenting nodulations or bulgings, which may attain a large size. They are also stiff and crippled in their movements, at last becoming quite immovable and rigid; and being either permanently flexed, extended, or sometimes even bent backwards. The interference with movement and the deformity do not bear any necessary proportion to each other, the one or the other predominating according to the mode in which the uratic deposit has taken place. The more this infiltrates the ligaments and surrounding tendons, the greater becomes the impediment to movement. The fingers are particularly liable to be much altered in chronic gout. A common condition is said to be stiff flexion of the metacarpo - phalangeal and second phalangeal joints of a finger, with over-extension of the first phalangeal joint, so that its knuckle presents a deep hollow. Deflexion of the fingers to the ulnar side of the fore-arm is observed in some gouty cases. The toes are also sometimes distorted towards the outer side of the foot.

Gouty concretions in connexion with joints feel hard, and by their mere mechanical and irritative effects they are liable to cause damage to the adjoining structures. They may be seen stretching or shining through the skin, and causing it to assume a bloodless appearance, or, on the other hand, rendering it congested and bluish, the veins also being enlarged. Ultimately a gouty abscess may form around a concretion, which opens externally; or the skin may merely give way from the continued pressure. Thus the *chalk-stones* are exposed, and may come away either in a liquid form or as solid particles or masses, or occasionally there is a free discharge of pus as well. Ulcers are left, of an unhealthy and atonic character, and usually presenting no disposition to heal. There may be a number of these ulcers in the same individual, on the hands and feet.

When bursæ are involved, much deformity is produced. They are easily felt, usually presenting a combination of hardness and fluctuation, due to the presence of both concretions and fluid in the bursal cavity. These signs are chiefly noticed in the bursa over the olecranon. Abscesses may also form in connexion with these deposits, and the latter may thus be completely got rid of, the abscess subsequently healing rapidly.

In cases of chronic articular gout the general system tends to become permanently affected. The patients are generally more or less feeble and wanting in tone; they may be thin and pale or sallow-looking; or plethoric, but with flabby tissues, and presenting signs of languid circulation, with enlarged capillaries about the face. They often suffer from disorders of digestion and other symptoms already described; but not uncommonly, as gout assumes a more chronic form, patients feel better, becoming habituated to their condition. It is remarkable that those suffering from numerous gouty abscesses often exhibit but little constitutional disturbance.

The urine in chronic gout generally becomes abundant, very watery and pale, of low specific gravity, deficient in solid ingredients, especially in uric acid, which at times may be almost completely wanting, or it may be thrown out in an intermittent manner. Deposits of urates in urine are not often observed in cases of advanced chronic gout, except perhaps before an acute exacerbation. Glycosuria is not uncommon in gouty persons, and there may be distinct saccharine diabetes. Oxaluria is also frequent.

4. **Irregular Gout.**—The clinical phenomena which are recognised as irregular manifestations of gout may assume either an acute or chronic form. They may be observed in persons who are distinctly subject to articular gout; or in those in whom the disease is not so obviously revealed. Moreover, their intensity is often in an inverse ratio to that of the joint-affection, and the two classes of symptoms may exhibit a remarkable tendency to alternation, when the articular symptoms are prominent those connected with other parts being slight or absent, and *vice versâ*. Acute symptoms are particularly liable to arise when, from any cause, during the progress of a gouty fit the joint-inflammation is checked suddenly or rapidly —*retrocedent gout*. At other times internal symptoms seem to be due to a want of development of the external phenomena—

suppressed gout; and when the latter appear, the former subside.

It must suffice to indicate here the general nature of the symptoms of irregular gout. The *acute* symptoms are mainly associated either with the digestive apparatus, the vascular system, the respiratory organs, or the nervous system. In connexion with the *digestive apparatus*, acute dysphagia may occur, attended with spasm of the pharynx and œsophagus. The most important symptoms belonging to this group are, however, those due to gastric disturbance. This may be of the nature of severe cramp or gastralgia, characterised by a sudden, intense, spasmodic pain in the epigastrium, relieved by pressure, and accompanied with a sense of great weight and oppression; the patient presenting an aspect of much suffering, distress, and anxiety; or being even more or less collapsed and prostrated. In other cases the symptoms are those of acute gastritis, bilious vomiting being prominent. Intestinal colic, or even muco-enteritis, may also occur in connexion with gout. Hepatic disorder is common. The *vascular system* is not uncommonly implicated. The heart is liable to be disturbed in its action during the attacks of gastralgia, but this disturbance may also be observed independently. There may be severe palpitation, the action of the heart being very rapid, irregular, or even intermittent, accompanied with most unpleasant sensations over the cardiac region, precordial anxiety, often a feeling of oppression or constriction, dyspnœa or a sense of suffocation, and much distress, anxiety, and dread of death; the pulse tends to be weak and small, or may be irregular; and sometimes the attacks are attended with signs of collapse. In other instances the cardiac disorder is evidenced by very feeble or slow action, with a tendency to syncope. Again, there may be all the phenomena of a severe anginal attack (*see* ANGINA PECTORIS). Irregular gout affecting the *respiratory system* is mainly indicated by asthmatic paroxysms. In some cases there is a marked liability to acute catarrh of the air-passages, and crystals of uric acid have been found in the expectoration. Bronchitis is more obstinate in gouty subjects. Pulmonary congestion is also supposed to be a manifestation of retrocedent gout in some cases; and gouty pneumonia has been described. In connexion with the *nervous system* gout may give rise to attacks of severe headache or vertigo; delirium or even acute mania; epileptiform or convulsive fits; cerebral or spinal meningitis; acute neuralgia, either external or internal, and especially sciatica, probably due to neuritis; or severe muscular cramps. Apoplexy from cerebral hæmorrhage has been attributed to suppressed or retrocedent gout, but this can only occur if the vessels of the brain are diseased. Cerebral congestion might give rise to a temporary apoplectic attack. Among the acute manifestations of irregular gout may be further mentioned certain skin-affections, as eczema, erythema, or urticaria; affections of mucous membranes, such as the conjunctivæ and lacrymal passages; functional renal disorder, with albuminuria, or irritability of the bladder; and external local signs of inflammation, associated with uratic deposit.

Many of the more *chronic* symptoms associated with gout have already been pointed out, when speaking of its premonitory symptoms, and only certain special phenomena need be alluded to here. Chronic skin-diseases are of frequent occurrence, namely, psoriasis, chronic eczema, prurigo—either local or general, and acne. These may alternate very distinctly with articular gout. The nails are sometimes peculiar, being coarse and fibrous, striated and fluted, or lined vertically. Their substance may grow thick and brittle. In some gouty subjects daily paroxysms of heat and redness of the nose, attended with severe itching and irritation, cause considerable annoyance or distress. Violent sneezing fits are common. Many of these individuals are also liable to chronic catarrh, affecting the throat and the air-passages; and special appearances of the throat, tongue, and teeth have been described. In course of time gouty patients often become permanently asthmatic, the lungs being emphysematous, and dry bronchial catarrh being established. Gravel or urinary calculus may give rise to symptoms; or those indicative of chronic urethritis or cystitis may be present, especially in persons advanced in years. Permanent disorders of sensation, or slight local paralysis, may result from chronic changes involving particular nerves. Gouty persons are usually very sensitive to pain. Certain affections of the eyes have been attributed to gout, and amongst them a form of gouty iritis, described by Hutchinson as coming on insidiously, and almost painlessly, and ending in destruction of the eye. Changes in the external auditory meatus may also be associated with this complaint.

With regard to tophi, these can be seen or felt, provided they are superficial. Those connected with the helix of the external ear are most common; but they may also be looked for in the sclerotic or eyelids, in the nose, and under the skin, in the region of tendinous aponeuroses, especially in the leg or thigh. Tophi are originally liquid, and if one is punctured at an early period, an opalescent or milky fluid escapes, which on microscopic examination is found to contain an abundance of delicate, acicular crystals; subsequently they become more consistent, and ultimately quite solid and hard, being then made up entirely of these crystals, which are closely aggregated together and interlaced. Taking the ear as an illustration, at first a small elevation appears under the skin of the helix, like a vesicle, having a soft feel. This gradually hardens, until finally a little bead-like or pearl-like body is formed, presenting a whitish colour as seen through the skin. In course of time the cutaneous covering may be destroyed, leaving the little concretion exposed; or this may even become detached and removed, so that only a small depression is left.

5. **Symptoms due to Chronic Organic Diseases.**—In addition to what has been stated under the preceding heading, it is only necessary to refer here to the renal and cardio-vascular changes which are associated with gout. Disease of the kidneys is indicated mainly by the changes in the urine, which may be slightly albuminous, or even contain a few casts. Other symptoms of chronic Bright's disease may be present, but they are often very obscure. The cardiac lesions are revealed by their respective physical signs; and there may be symptoms, first of excessive cardiac action from hypertrophy, and subsequently of cardiac failure, as well as those of particular valvular diseases. The vascular changes are evidenced by examination of the arteries; and by their effects upon the circulation. It is impossible to describe within the limits of this article the numerous symptoms resulting from the various chronic organic diseases which may develop during the progress of gout, and which in many cases ultimately produce a very complicated clinical picture.

DIAGNOSIS.—The degree of difficulty experienced in arriving at a diagnosis with respect to gout is very variable in different cases. A distinct gouty diathesis or tendency may be present, which it is important to recognise, while the joints are quite free from any apparent mischief. In most cases, however, the diagnosis has to deal with the nature of an articular affection, and to determine whether this is gouty or not. The chief diseases from which gout has thus to be distinguished are acute or chronic rheumatism, rheumatoid arthritis, and possibly gonorrhœal synovitis. The data upon which a conclusion has usually to be formed with regard to a first attack, are the presence or absence of an hereditary tendency to gout, as well as its intensity; the age and sex of the patient; the social position, occupation, and previous habits; the presence or absence of any obvious cause for the attack, or of premonitory symptoms; the localisation and characters of the joint-affection; the general symptoms; the characters of the urine; the duration of the illness; and the absence of any cardiac complication.

The subsequent progress of gout is important in diagnosis, with its tendency to periodic recurrence; and if the metatarso-phalangeal joint of the great toe is alone inflamed several times in succession, or even if only the smaller joints of the feet and hands are implicated, the diagnosis of gout is tolerably certain. The permanent articular changes induced by gout also become evident in time; as well as, perhaps, tophi in other parts, which should be carefully searched for in any doubtful case. Moreover, the urine presents peculiar changes as the disease progresses, and may give evidence of renal mischief. In very doubtful cases it might be desirable to raise a blister, or even to take a little blood from the patient, and endeavour to obtain crystals of uric acid from the serum.

It will here be expedient to offer a few remarks as to the diagnosis from gout of the diseases with which it is most likely to be confounded.

With regard to acute rheumatism, the absence of any hereditary tendency to gout in any doubtful case may be in its favour, and possibly there may be a family predisposition to this complaint. It occurs most frequently for the first time in early life, from sixteen to twenty years of age, and is not uncommon even in young children. Rheumatism, though more common among males, often attacks females. It is not favoured by the habits which generate or promote gout, and affects all classes of persons, but especially those who from their occupation are liable to be exposed to cold and wet. Such exposure, or some other definite cause originating 'a cold,' usually accounts for an attack of acute rheumatism; and it is not preceded by any particular premonitory symptoms. The joints involved are the middle-sized or the larger ones, several of which are generally implicated in succession during the illness, the rheumatic inflammation exhibiting an erratic character; the local symptoms tend to be less severe than in gout; there is less marked œdema about the joints, and no enlargement of the veins, or subsequent desquamation. It must not be overlooked, however, that gout may attack the middle-sized joints. Pyrexia is high as a rule in acute rheumatism, and is often quite out of proportion to the extent of the articular affection; while profuse acid perspiration is almost always a prominent phenomenon. The urine is simply febrile. The attack lasts a considerable time, perhaps several weeks, if it is at all severe; while during its course some acute cardiac inflammation is very liable to supervene. In addition to other differences, chronic rheumatism is at once distinguished from gout by the entire absence of uratic deposits.

Rheumatoid arthritis is usually met with in females between twenty and forty years old. There is neither hereditary taint, nor a history of such habits as generate gout, but, on the contrary, the patients are generally poor, hard worked, and badly fed; all joints seem to be equally liable to be affected, both large and small, and the local symptoms are not of a very acute character, though the pain may be very severe, but they tend to continue for a long period; the general symptoms are mainly those of debility and anæmia, and Dr. Kent Spender has drawn attention to certain prominent and early symptoms, especially cold hands and feet, constant dampness of the hands, pigmentation of the skin, and a rapid and compressible pulse. Rheumatoid arthritis is a disease which tends to progress, involving joint after joint, but it presents no periodicity in its attacks, and often advances without any intermission, as a subacute or chronic disease. Ultimately it often causes much deformity and crippling of the articulations, which creak and grate on movement, but this results from a very different pathological change from that which takes place in gout, for there is not the slightest deposit of urates, either in the joints or elsewhere; nor in the most extreme cases can any uric acid be obtained from the serum. The urine presents no special characters; and the kidneys are not diseased.

Gonorrhœal synovitis is distinguished from gout by the age of the patient; the distribution of the joint-affection; the absence of any tendency to recurrence, except in association with a fresh urethral discharge; and the different nature of the morbid changes, tophi never being formed.

As exceptional points bearing upon the diagnosis of articular gout, the following may be mentioned. It has happened that pyæmia beginning in the great toe has been mistaken for gout, but the progress of the case would soon clear up any doubt under such circumstances. Again, articular inflammation from injury might resemble gout; and, moreover, it must be borne in mind that such an injury may really set up gouty inflammation for the first time, so that the joint may not recover properly. In some individuals the ends of the phalanges of the fingers are enlarged, especially the terminal ones, and cause nodulations—*digitorum nodi*—which resemble those of gout, and are by some regarded as being of a gouty nature.

The importance of recognising the signs of the gouty diathesis, apart from the joint-affection, has already been alluded to. Equally important is it to be prepared for the acute symptoms in connexion with internal organs which occur in this diathesis, whether along with or independent of articular disease. Lastly, in any gouty case the detection of the organic diseases liable to be set up in its course is of great moment in diagnosis, especially renal and cardio-vascular changes; and also the association with their proper cause of catarrhal affections, skin-diseases, and other complaints, when these are really of a gouty nature.

Prognosis.—The first point relating to the prognosis of gout which calls for notice refers to the immediate dangers in any particular case. A simple acute attack of articular gout rarely, if ever, kills the patient. When, however, internal organs are implicated, the matter becomes much more serious, and a fatal result may occur, so that the prognosis must be a guarded one under such circumstances. The danger then becomes much greater if the complaint has been long-established, and if the kidneys or other important organs have become structurally diseased. Indeed, these diseases of organs are often themselves immediately dangerous. Again, any acute inflammation occurring in a confirmed gouty subject is the more serious on this account; and the same remark applies to injuries and shocks of all kinds.

In the next place, the future of a gouty patient has to be considered, as regards the prevention of subsequent attacks, or the cure and eradication of the disease. It must always be recognised that gout is a recurrent affection, and complete immunity can never be guaranteed, once the complaint has declared itself. At the same time undoubtedly not a few cases have occurred in which there has been but one attack, but this can only be expected under certain conditions. In giving an opinion on this point, the prognosis in any individual case will depend upon:— 1. The degree of hereditary tendency to gout. 2. The age of the patient; for the earlier the period at which the disease begins, the less hopeful is the prospect of a cure. 3. The time the complaint has lasted from its commencement; and the frequency and duration of the gouty fits. If gout has become established, and especially if distinct tophi have formed, it is quite impossible to eradicate it. 4. The habits, mode of living, and occupation of the patient. It is only when the patient is prepared to adhere strictly to proper rules of living that a cure can be hoped for. Those who in their occupation are tempted to drink much, or who are exposed to cold or wet, are much less likely to be cured. It may be remarked here that gouty subjects are less able than others to resist exposure.

Another point bearing upon prognosis refers to the duration of life in gouty persons. If the disease comes on late in life, and the paroxysms only occur at long intervals, while the organs are free from any organic mischief, gout may not appreciably shorten life, and the patients may even enjoy good health up to an extreme old age, provided they are sufficiently careful in their mode of living, and no accidental complications arise. Chronic gout does, however, unquestionably tend to shorten the duration of life, to a greater or less degree in proportion to its severity, and more especially to the indications present that the kidneys, heart, arteries, or other important organs are organically diseased. This tendency is now recognised by most life-insurance companies.

It has been affirmed that gout is a protection against certain other diseases, such as phthisis and diabetes, and therefore its presence has been in some instances regarded as a benefit, but how far there is any real foundation for this belief is a matter of very considerable doubt.

Treatment.—It is important at the outset to lay stress upon the fact that, although there are certain well-defined principles applicable to the treatment of gout in its various phases, it is a great mistake to follow any regular routine method under all circumstances, and every case must be considered on its own merits. It will be convenient to discuss this part of the subject under certain general headings, premising that the administration of medicines is often the least important part of the treatment, and that the habits of life of the patient always need thorough supervision in all their details.

1. Preventive and Curative Treatment.—In a number of cases the primary object which should be aimed at is to prevent the development of gout; or to eradicate the tendency to subsequent attacks, if it has once declared itself. These objects have especially to be kept in view in dealing with individuals who have a marked hereditary predisposition to the complaint; in cases where it has appeared at a comparatively early period of life, or where it is in an early stage; and in persons who, from their occupation, known habits, or the symptoms they present, are likely to become gouty. Moreover, even when confirmed gout has been established, preventive treatment may diminish the number of acute attacks, or possibly even avert them altogether; as well as obviate the implication of organs essential to the well-being of the economy. In order to carry out these purposes in any particular case, the patient must intelligently recognise the fact that success in treatment mainly depends upon himself, and upon his willingness constantly to regulate his mode of living according to principles suitable to his condition, which need to be more or less strict in different instances. The general nature of the rules to be adopted will be evident from a consideration of what has been stated in discussing the ætiology and pathology of gout, but they require to be briefly noticed here.

(*a*) *Diet.*—Moderation in the quantity of food is the first point to be attended to in the treatment of the gouty diathesis. It is not necessary or desirable to restrict persons who are gouty to a very low diet, especially if they are in any way weak, but an amount sufficient for proper nourishment in each individual case must be consumed, and at no meal should the stomach be uncomfortably filled. The meals must be taken at regular times, and not hurriedly, so as to avoid bolting of the food. Very late dinners, as well as suppers, should be prohibited, but it suits many persons better to dine at six or half-past six o'clock than at midday. The nature of the food is highly important. It is quite unnecessary, and probably would be in most instances injurious, to restrict the patient absolutely to a vegetable diet, but a due proportion of animal and vegetable aliments should be allowed. At the same time, in persons who have any tendency to gout, an essential part of the treatment often consists in diminishing the amount of meat which they consume, and they should not take it more than once a day. Indeed, the aim must be to reduce all kinds of nitrogenised food, whether animal or vegetable, to such an amount as the system can satisfactorily dispose of, with due regard to the proper nutrition and strength of the body. As regards the kinds of animal food which are suitable for gouty subjects, white fish, chicken or fowl, game, tripe, sweetbread, and mutton are the best forms. Tender and underdone beef may be taken in moderation from time to time, if it is readily digested. Pork or veal, dried and salted meats, and rich dishes of all kinds, should be avoided. Lightly boiled or poached eggs may be permitted. Vegetables which contain much woody fibre, or which create flatulence, must be eschewed; and certain articles, such as rhubarb, tomatoes, especially when cooked, asparagus, and sorrel, are often injurious to the gouty, as well as others which contain much acid. On the other hand, some special beneficial influence has been attributed to celery. Those who are subject to gout should either abstain altogether from, or only take a very limited quantity of, sugar and saccharine articles of diet. Hence, although digestible fruits may often be taken with advantage in moderation, those which are very sweet must be used with particular caution. Stewed and baked fruits often agree well, but fruit-tarts, and, indeed, pastry of all kinds, should be interdicted. The juice of oranges or lemons is considered beneficial for gouty persons. Starchy foods are permissible in moderation. It may be laid down as a rule to be invariably followed, that gouty patients should limit themselves to simple meals, and not indulge in a number of courses; and that they should avoid everything which experience tells them is, in their case, indigestible.

(*b*) *Drink.*—The question of drink demands the most careful consideration and attention in every case in which gout is either threatened or has become established. No stringent rules can be laid down, applicable to all cases, but there are certain broad principles which have to be borne in mind. An abundance of good and pure drinking-water is to be commended, but it should be taken mainly apart from meals. It is a good plan for the subjects of lithiasis to take a tumblerful of, either cold or hot, water before retiring to rest at night. Effervescing potass- or lithia-water may be substituted for ordinary water with advantage, but not soda-water. Tea and coffee may be taken in moderation, provided they do not disagree. With reference to alcoholic drinks, in a considerable number of instances one of the first objects in the treatment of the gouty diathesis should be the regulation of the use of this class of beverages. This indication is obvious enough when the condition is evidently due mainly to intemperance; but even when the patient is temperate, it may be that in his case the amount consumed needs to be reduced or total abstinence enforced, especially if there should be a strong hereditary predisposition to gout, or if the complaint appears in early life. Some patients are undoubtedly better if they take no stimulants whatever; others, however, can take those of a proper kind, and of good quality, in strict moderation, with advantage. It may be laid down as a general rule that malt liquors and all stronger wines are injurious, and should be interdicted. Those which are most suitable are sound light claret, hock, moselle, chablis, or sauterne. A small quantity of good dry sherry suits some gouty patients very well. A little brandy, well diluted, often agrees better than any other kind of alcoholic liquor; in other cases whisky or gin answers best. Whatever stimulant is selected, it should only be taken at meal-times, and the habit of drinking between meals is strongly to be deprecated. Persons who are distinctly gouty should avoid any excess on every occasion; and even if they do not absolutely abstain, they may find it beneficial to do so from time to time, especially if there is a tendency to the development of gouty symptoms.

(*c*) *General hygiene.*—Inadequate exercise is a hygienic error which has frequently to be rectified in the treatment of the gouty state. Sedentary habits must be combated, whether due to occupation or indolence; and it must be insisted upon that a due amount of outdoor exercise is taken daily, but prolonged exertion, tending to cause fatigue and exhaustion, must be avoided. Walking and horse-exercise are highly beneficial, especially in the case of those who live rather too freely. Even carriage-exercise is useful, so that the patient may have the benefit of the fresh air. For those who cannot have much regular exercise, lawn-tennis, fencing or single-stick, golf, and the like may be serviceable. As bearing upon the prevention of an acute fit of gout, it is an undoubted fact that some individuals who are subject to the disease seem to be able to ward it off by walking, riding, or adopting some other form of prolonged and violent exercise on the first intimation of a threatened attack. Gouty persons should retire to rest and get up early. They should as much as possible avoid excessive mental labour, or any great strain upon the mental faculties, but especially worry and anxiety of all kinds. Attention must be paid to the cutaneous functions, the surface of the body being also protected from the injurious effects of cold. Warm clothing should be worn, in keeping with the weather, and those who can bear it should wear flannel next the skin. With regard to baths, many gouty persons are decidedly the better for using a cold or tepid bath every morning, followed by energetic friction; in other cases the employment of the warm bath at intervals, or even of the Turkish bath, answers best. A course of treatment in a hydropathic establishment from time to time, under due medical supervision, is sometimes decidedly beneficial. Climate demands attention, whenever the circumstances of the patient allow a choice to be made. It may be advisable for gouty subjects to reside permanently in some warm and equable climate, or at any rate during the winter and early spring. In this way attacks may often be warded off, and the disease thus prevented from making progress. Those who are obliged to remain in this climate during the inclement seasons should avoid exposure to wet and cold, as well as sudden changes of temperature, and night air. The bedroom should be warm and well-ventilated; and in cold weather it is desirable to keep a fire burning during the night. Unduly heated and badly ventilated rooms, as well as crowded places of public resort, must be eschewed.

(*d*) *Medicinal treatment.*—There can be no doubt but that the judicious use of certain medicines may assist materially in warding off or mitigating the gouty condition, and in preventing the occurrence of acute paroxysms. Those which are specially called for in cases of established chronic gout will be presently considered. In the meantime, it may be stated that the digestive functions require particular attention, and medicines which help these functions are often of the greatest service, if they should be disordered. A course of alkalis or acids, according to the indications in each case, may prove most serviceable, combined with some simple bitter infusion or tincture. Certain alkalis and alkaline earths are also valuable on account of their power in promoting elimination of lithic acid, by forming soluble salts with this acid. The careful observations of Dr. Haig have shown that alkalis increase the secretion of uric acid, while acids decidedly diminish it. The alkalis which are most useful are salts of potassium and lithium, the urate of lithium being the most soluble of all. The bicarbonate of potassium, carbonate of lithium, or the citrates are the best salts to administer. They should be taken well-diluted, and on an empty stomach. Magnesia or its carbonate may be given with advantage if there is much acidity, and if the bowels are habitually constipated. Saline aperients are often of great service, and they may be advantageously administered in small doses, freely diluted, and regularly repeated, when they also act on the kidneys. In many cases other aperients may be employed at intervals with advantage, but strong purgatives must be used with particular caution. An occasional dose of blue-pill or calomel may be decidedly beneficial. The administration of other cholagogues from time to time may also be of service.

(*e*) *Mineral waters and baths.*—Certain mineral waters are of great value in the treatment of the gouty diathesis, when employed under proper medical supervision, and they offer the advantage that patients will often use them, when they will not undergo a course of regular medicinal treatment; while the water thus taken internally is itself of service. Space will not permit a long discussion of this subject here, and it must suffice to mention that in different cases the kind of mineral water employed must be varied according to the object desired to be accomplished, and according to the indications presented by the patient, for what suits one may be highly injurious to another. These waters are employed both internally and in the form of baths. Those chiefly used in gouty conditions are the waters of Bath, Buxton, Cheltenham, Clifton, Harrogate, Leamington, Malvern, and Woodhall in this country; Strathpeffer and Moffat in Scotland; Llandrindod in Wales; Lisdoonvarna and Lucan in Ireland; and Carlsbad, Marienbad, Vichy, Wiesbaden, Baden-Baden, Ems, Royat, Aix-la-Chapelle, Aix-les-Bains, Evian-les-Bains, Contrexeville, Dax, La Bourboule, Luchon, Friedrichshall, Hunyadi Jànos, Pullna, Schlangenbad, Teplitz, Seidlitz, Homburg, Kissingen, Rubinat, Wildbad, Ragatz, Gastein, Elster, Tarasp, Apollinaris, and other continental waters. Some of these may be taken regularly or at intervals, for the purposes which they respectively fulfil; or, if circumstances permit, a systematic course of treatment from time to time, at certain of the places mentioned, may be recommended. *See* MINERAL WATERS.

Before leaving the subject of the preventive treatment of gout, it needs to be insisted upon that those who are particularly liable to this disease, whether from hereditary predisposition, occupation, or any other cause, should pay special attention to preventive measures; and also that those in whom the disease has already manifested itself must take every precaution to avoid the known causes of acute attacks, for each attack tends to make matters worse.

2. Treatment of Acute Gout.—When a fit of acute articular gout sets in, it is on no account to be permitted to run its course unmodified by treatment, else serious mischief is liable to arise. At the same time it is requisite to refrain from adopting too active measures. Our objects should be to shorten the attack; to restore the affected parts as nearly as possible to their normal condition; and to relieve symptoms. In the first place, particular attention must be paid to the *diet.* The aim should be to make this as low as is compatible with the condition of the patient, especially if the fit is of a very acute and sthenic type. In young and strong patients the diet should at first consist of milk, farinaceous articles, and abundance of water, barley-water, or toast-and-water. Those who are advanced in years, weak, or broken-down in health, or who have long suffered from gout, require a more nutritious diet, but it should be easily digestible, consisting of beef-tea and good soups, milk, eggs beaten up, and such articles, the quantities being regulated by the requirements of each case. As the symptoms subside, the food should be gradually improved, white fish, fowl, and meat being allowed in succession, but in strict moderation; and due care must be exercised subsequently. If possible, all kinds of alcoholic stimulants should be interdicted, but it may not be judicious to cut them off entirely in some cases, either on account of the previous habits or present condition of the patient, and then it is best to give a definite quantity of brandy or whisky, well diluted, with the food. For those who cannot take spirits, a little good hock or sauterne answers well.

As regards *medicinal* agents, colchicum has long held the most prominent place in the treatment of acute gout, and is commonly regarded as a specific. There can be no doubt as to the influence of this drug in relieving the symptoms and shortening the paroxysm of gout, although it is by no means settled how it acts. Its effects must be watched, however, for it does not agree in every case. It has been alleged that colchicum renders the patient more liable to subsequent attacks of gout, but for this notion there does not seem to be any real foundation. The tincture or wine of colchicum may be given in doses of ten to twenty or even twenty-five minims every four or six hours, and either of these preparations may be combined with the citrate or bicarbonate of potassium or with a salt of lithium.

Salicylates, especially salicylate of sodium, have been much recommended in the treatment of acute gout, and Dr. Haig is strongly in favour of them, having found that they materially increase the discharge of lithic acid. They certainly have proved useful in some cases in the writer's experience. Another class of drugs employed are antipyrine, antifebrin, and allied agents. A remedy named piperazin has been introduced for the treatment of gout, which is said to be the most powerful solvent of uric acid known, but the writer has no experience of its practical use.

It is necessary to keep the bowels acting freely by means of suitable aperients, and saline purgatives are of considerable value for this purpose. Other aperients, such as compound rhubarb pill, colocynth, podophyllin, calomel or blue pill, may be employed in appropriate cases. Diluents may be given freely, in order to promote the action of the kidneys; and if the cutaneous functions appear to be defective, some mild diaphoretic may be administered, or it may even be desirable to employ the hot-air or vapour bath. Medicines may be needed for the relief of symptoms, especially pain and sleeplessness, for which Dover's powder or other preparations of opium, belladonna, chloral hydrate, sulphonal, or bromides may be indicated, but they must be used with discretion. In very severe cases hypodermic injection of morphine is of much service.

Venesection ought never to be practised in the treatment of acute articular gout; for although immediate improvement may perhaps be thus produced, the ultimate results are highly unsatisfactory. Even the local removal of blood, by means of leeches applied near an affected joint, is dangerous, and had better be avoided, on account of the permanent local mischief which such a measure is liable to induce.

Local treatment.—The affected parts in acute gout should be kept entirely at rest, and placed in a comfortable position, supported by pillows, and either horizontal or elevated, according to the feelings of the patient. In ordinary cases it is sufficient to wrap up the joints in flannel, or to surround them with cotton-wool completely covered with oil-silk or gutta-percha sheeting, according to Garrod's method, by which means a kind of local vapour-bath is kept up. If the pain is considerable, other local applications might be used, of which the most efficient are warm fomentations, to which tincture of opium or belladonna may be added, poppy fomentations, lead and opium lotion, localised steaming, belladonna liniment, tincture of aconite, oleate of morphine, or a solution containing morphine and atropine. Some practitioners prefer evaporating lotions containing alcohol, ether, or chloroform; others warm water compresses. A blister in the neighbourhood of a gouty joint may be of service, if the attack be asthenic, and also if effusion or much stiffness persist. During recovery, benefit may be derived from careful friction with some stimulating liniment, application of iodine, shampooing, gentle passive movements, douching with salt and water, or the application of a light bandage or elastic support, should there be a tendency to permanent thickening and stiffness, or to œdema and enlargement of the veins.

The acute forms of *irregular gout* must be treated according to their nature, and here it must suffice to offer a few general remarks on the subject. If serious internal symptoms arise, which are distinctly of a gouty nature, and especially if they occur as retrocedent phenomena, it is important to try to excite inflammation in the joints, by means of local heat, friction, and sinapisms. Colchicum may be of service in the non-articular, as well as in the articular form of gout. In painful affections opium or other anodynes are called for; and frequently the administration of alcoholic and other stimulants is indicated, with antispasmodics, such as ammonia, ethers, camphor, musk, or belladonna, especially when the stomach or heart is affected. In conditions attended with signs of much depression or collapse, external heat may be applied over the body, or sinapisms to the limbs and over the cardiac region. In the treatment of inflammatory diseases associated with gout much care is required, especially in resorting to depletory measures. The existence of the diathesis must always be borne in mind.

3. **Treatment of Chronic Gout.**—When gout becomes an established chronic disease, the same general rules of treatment are to be observed as in the prevention or attempted cure of the complaint, but they often need modification in particular cases, according to the conditions present. Similar medicinal remedies are also indicated, lithium salts being particularly valuable, and they may even aid in removing gouty deposits; but others may be added to the list, which are suitable in different cases. Colchicum is often of much service, taken habitually or from time to time, in the form of one of the extracts at night, or a few minims of tincture or wine two or three times a day, combined with other medicines. Among the many therapeutic agents recommended in the treatment of chronic gout under different circumstances may be mentioned benzoic acid or benzoate of ammonium, phosphate of ammonium or of sodium, iodide of potassium, bromide of potassium, carbonate of aluminium, lime-juice, resin of guaiacum, ammoniacum, and tonics, especially quinine, tincture or infusion of cinchona, or mild ferruginous preparations. Undoubtedly most of these are of use in appropriate cases of chronic gout, to serve their special purposes, but they must be used judiciously, especially iron. Symptoms connected with various organs frequently call for attention in this disease, and they must be treated by appropriate remedies. It may be remarked that, should diarrhœa set in in gouty cases, it must not be hastily arrested, as this may be a mode of relief to the system. With regard to the local conditions in chronic gout, it is affirmed that the prolonged use of some of the mineral waters previously mentioned, both internally and in the form of baths, such as those of Aix-la-Chapelle, Aix-les-Bains, and Baden-Baden, may succeed in removing to some extent deposits of

urates, and in diminishing stiffness and thickening of joints. For these purposes local measures may also be of service in some instances, provided the morbid changes are not too far advanced, namely, occasional blistering or application of iodine; the prolonged use of wet bandages; friction with liniments; shampooing and passive movements; or systematic compression by means of some non-irritating plaster. Solutions of alkalis or alkaline carbonates, and especially of carbonate of lithium, have been kept applied to gouty joints and other parts for a long time, under the belief that deposits of urates may be thus dissolved. In the writer's experience no such effect has ever been thus produced, although the constant application of warm moisture may be useful. Superficial uratic deposits should not be interfered with unless they become troublesome, when it may be desirable to puncture the skin, and let the contents out. The propriety of removing large masses by operation may come up for consideration, but this should only be attempted if there is every probability that they can be entirely removed without any serious difficulty, and if the patient is in a fit state for the operation. When abscesses or ulcers form, they come under the treatment of the surgeon; but it may be observed that simple dressings usually answer best in these cases, and they may sometimes be advantageously dressed with solution of carbonate of potassium or lithium. It must not be attempted to heal them up too rapidly, as the discharge may be a relief to the system, and it may even be necessary to enlarge the opening of a gouty abscess. Under any treatment it is by no means an easy matter to induce lesions of this kind to heal in cases of chronic gout.

The treatment of the various chronic organic diseases which are liable to arise in the course of gout must always be kept in mind, but the reader is referred to other appropriate articles for a consideration of this part of the subject.

FREDERICK T. ROBERTS.

GRAHAM'S TOWN, in Cape Colony.—*See* AFRICA, SOUTH.

GRAND MAL (Fr.)—A term applied to epilepsy when it assumes the form of a severe convulsive attack. *See* EPILEPSY.

GRANULAR KIDNEY.—A morbid condition of the kidney, in which this organ is the seat of fibroid change, and as a result becomes contracted, hard, and granular. *See* BRIGHT'S DISEASE.

GRANULAR LIVER.—A synonym for cirrhosis of the liver, in which the organ presents a granular appearance, on its surface and on section. *See* LIVER, Cirrhosis of.

GRANULATION (*granulum*, a little grain).—In medical pathology, granulation is synonymous with tubercle in its isolated form, the individual tubercles being called 'grey' or 'yellow' granulations, according to their appearance (*see* TUBERCLE). In surgical pathology, the term 'granulations' is applied to small vascular prominences, consisting of embryonic tissue, growing on the surface of wounds or ulcers, and by which the healing process is carried on—whence the expression 'healing by granulation.' When granulations assume the appearance of an exuberant growth they constitute what is called 'proud flesh.' *See* CICATRISATION; and ULCER and ULCERATION.

GRAVEL.—DEFINITION.—The deposit in and escape from the urinary passages of gritty particles with the urine.

ÆTIOLOGY.—The same causes which produce dyspepsia are frequently productive of lithic-acid gravel, such as indolent habits, excess of food and drink—especially of nitrogenous and saccharine articles, and the too free indulgence in the use of fermented liquors. Endemic causes connected with climate and the nature of the drinking-water, hereditary predisposition, and many slight or serious organic diseases, may explain the appearance of gravel in those, and especially in women, who commit no dietetic excess, or who are total abstainers. *See* OXALIC-ACID DIATHESIS; PHOSPHATIC DIATHESIS; and URIC-ACID DIATHESIS.

VARIETIES.—Gravel may be composed of (1) lithic acid and its compounds; (2) oxalate of lime; (3) phosphate of lime; or (4) the triple phosphate. By far the most common form of gravel, and that which alone need now be considered, is lithic acid. This, owing chiefly to its great insolubility, is frequently deposited in the kidney and bladder, and is seen in the newly passed urine in the form of the well-known reddish-brown crystals, often described as resembling cayenne-pepper grains. The supernatant urine is generally clear, rather dark in colour, and of a distinctly acid reaction.

SYMPTOMS.—The passage of uric-acid crystals or gravel frequently causes no subjective symptoms, and is consistent with perfect health. Sometimes, however, it gives rise to, or is accompanied by, both general and local disturbance of function. The general symptoms are those of dyspepsia—namely, flatulence and heartburn after meals, eructations, headache, muscular cramp, depression of spirits, and a sense of malaise. Locally, there is dull aching in the lumbar region, not increased by movement; frequent micturition; a sense of heat and irritation at the neck of the bladder and along the urethra, especially during and after voiding water; and sometimes the appearance of a faint cloud of mucus or a slight tinge of blood in the urine.

Treatment.—From what has been said, it follows that the most important points in the treatment of gravel are strict limitation as to the *quantity* of food; the avoidance of highly seasoned, very rich, or sweet dishes; the preference for vegetable rather than for animal food; abundant exercise in country air; and abstention from or the very sparing use of alcoholic liquors. Medicinally there may be given diuretics to increase the quantity of the urine, and facilitate the escape of gravel; pure water, alkalis, and alkaline waters freely diluted, to act as solvents of uric acid; and saline aperients and saline waters, to promote digestion, and assist in ensuring the free action of the liver and alimentary canal.

W. Cadge.

GRAVES'S DISEASE.—A synonym for exophthalmic goître, to which the late Dr. Graves, of Dublin, called special attention. *See* Exophthalmic Goître.

GREEN-SICKNESS.—A popular synonym for chlorosis, applied on account of the greenish colour of the skin sometimes present in that disease. *See* Chlorosis.

GRIPPE (Fr.)—A French synonym for influenza. *See* Influenza.

GROWTH, Disorders of.—*See* Atrophy; Hypertrophy; and Malformations.

GRUTUM.—Synon.: *Milium*, a millet seed.

This name is applied to small globular pearly-white bodies seen under the cuticle of the face, especially near the eyelids. They are about the size of a pin's head, and consist of distended sebaceous glands, the duct of which has been occluded. They should be distinguished from comedones, which are formed in over-distended follicles. When pricked with the point of a lancet, and pressed with a large watch-key, a small, perfectly globular cast of the sebaceous gland is squeezed out, which is quite unlike the long cylinder of the comedo. *See* Comedones.

Robert Liveing.

GUINEA-WORM.—*See* Entozoa.

GUMBOIL.—*See* Mouth, Diseases of.

GUMMA (Lat., gum).—A growth occurring in syphilis, so named on account of its supposed superficial resemblance to gum. *See* Syphilis.

GUMS, Diseases of.—*See* Mouth, Diseases of.

GURGLING.—A physical sign heard on auscultation of the chest or abdomen in certain conditions, due to the movement of gas and fluid within a cavity, whether normal or abnormal. A gurgling sensation may also be felt at times in the intestines, as over the cæcum in typhoid fever. *See* Physical Examination.

GUTTA ROSEA (*gutta*, a drop; *rosea*, rosy).—A synonym for acne rosacea. *See* Acne rosacea.

GYMNASTICS (γυμνός, naked).—*See* Exercise.

GYNÆCOLOGY (γυνή, a woman; and λόγος, a word).—This term in its literal sense means a doctrine or discourse concerning women. In modern medical language, it comprehends the study of the diseases peculiar to women. *See* Women, Diseases of.

H

HABIT OF BODY.—This expression signifies the sum of the physical qualities of an individual, and is sometimes used as synonymous with *constitution*. We speak of a *full* habit, a *spare* habit, and an *apoplectic* habit.

HABITS.—*See* Disease, Causes of; and Personal Health.

HÆMACYTOMETER (αἷμα, blood; κύτος, a cell; and μέτρον, a measure).—An instrument by the aid of which the number of corpuscles in a given volume of blood can be ascertained.

Description.—All methods employed for this object consist in making a definite dilution of a certain quantity of blood, and counting the number of blood-corpuscles in a certain volume of this dilution. Vierordt, who originated the method, drew uniform lines of diluted blood upon a slide, and, after it was dry, counted the corpuscles in a certain length of line. Cramer substituted for these lines what may be termed a capillary cell; and Potain and Malassez employed a capillary tube, and a microscope provided with an eyepiece ruled in squares. Hayem substituted for the tube a cell, the depth of which gave one dimension of the volume of dilution, while the lines upon the eyepiece furnished the others. The writer's instrument is an adaptation of Hayem's, with certain modifications: the diluting apparatus is similar, but of different capacity, and the lateral dimensions of the volume of dilution examined are obtained, not by a microscope-eyepiece, but by lines engraved upon the glass slide at the bottom of the cell, on which the corpuscles quickly fall. The instrument can thus be used with any microscope, an important convenience in practical use. The alteration in the capacity of the diluting measures facilitates the counting, and provides a much simpler mode of statement of the result. The apparatus, which is made by Hawksley, consists of (1) a pipette, graduated to 995 cubic millimeters, for measuring the diluting solution; (2) a capillary tube for measuring the blood, containing five cubic mm.; (3) a small glass jar and stirrer for making the dilution; and (4) the cell for counting, ·2 mm. deep, and ruled at the bottom in squares, each ·1 mm. in length and breadth. The slide bearing the cell is fixed on a small metal plate, to which two springs are attached; these keep the cover-glass in position, and secure uniformity in its pressure on the cell, and therefore in the depth of the contained liquid.

Various solutions have been employed for making the dilution. That which the writer has found to answer best, as differentiating most clearly the red and white corpuscles, consists of sulphate of sodium, 104 grains; acetic acid, 1 drachm; distilled water, 6 ounces.

In using the hæmacytometer, a drop of the dilution is placed in the centre of the cell; the cover-glass and springs are applied; and in a few minutes the corpuscles have sunk to the bottom of the cell, and are seen lying within the squares. The dilution of 5 c.mm. of blood in 995 c.mm. of solution, is 1 in 200; each square contains the corpuscles from a volume of dilution ·2 mm. in one, and ·1 mm. in each of the other dimensions—that is, 2 cubic ·1 mm., or the ·002 part of a cubic mm. But the dilution being 1 in 200 this volume of dilution contains just ·00001 cm. of blood. The number of corpuscles in a square, multiplied by 100,000, is thus the number in a cubic millimeter of blood—the common mode of statement. In order to limit error, the number of corpuscles in ten squares should be counted, and this number multiplied by 10,000 is the number per cubic millimeter. The average number in health is about 5,000,000. Blood of normal richness thus contains about 50 corpuscles per hæmacytometer square. Therefore, the number in two squares of the instrument will always represent the proportion of the corpuscular richness compared with that of normal blood (= 100)—that is, the percentage proportion to normal. It is, therefore, convenient to take the volume of blood represented by the two squares (·00002 cubic millimeter) as the standard volume, or 'hæmic unit.' For instance, it is found that the blood diluted presents in ten squares 375 corpuscles or 75 in two squares ('hæmic unit')—that is, 75 per cent. compared with the normal. To learn the number per cubic millimeter we have only to multiply 375 by 10,000 = 3,750,000.

In counting the white corpuscles, if they are not in considerable excess, it is most convenient first to ascertain the number of red corpuscles per square, and note how many squares are contained in a field of the microscope. If, then, the focus is raised, so that the corpuscles become indistinct, the white ones, from their higher refracting power, will appear like bright points, and the number in a series of fields can easily be counted. For example, the number of red corpuscles per square has been found to be 40, and the field contains 15 squares, that is, 600 corpuscles per field. Ten fields contain 15 white corpuscles; the proportion of white to red will, therefore, be 1 to $\frac{600 \times 10}{15} = 1$ to 400.

With this apparatus we may readily ascertain, within a small limit of unavoidable error, the corpuscular richness of the blood, an important element in many morbid states, such as anæmia; and we can thus ascertain the indications for, and observe the effect of, therapeutic agents. It is, however, very desirable in these cases to ascertain also the richness of the corpuscles in hæmoglobin (*see* HÆMOGLOBINOMETER). Both elements being ascertained and stated in the same terms (percentage), the quality of each corpuscle may be expressed in the form of a fraction. If the blood contains 60 per cent. of corpuscles and 40 of hæmoglobin, the average 'value' of each corpuscle $= \frac{40}{60}$ or $\frac{2}{3}$ the normal.

The hæmacytometer may also be employed for ascertaining the globular richness of milk or other liquids.

W. R. GOWERS.

HÆMATEMESIS (αἷμα, blood; and ἐμέω, I vomit).—SYNON.: Fr. *Hématémèse*; Ger. *Blutbrechen*.

DEFINITION.—Vomiting of blood, dependent on a variety of morbid conditions.

ÆTIOLOGY AND PATHOLOGY.—Hæmorrhage into the stomach may arise: 1. From the laying open of an artery. 2. From venous or capillary congestion of the mucous membrane. 3. From causes affecting the blood itself, so that it tends to transude through the vessels under pressure of the circulation.

1. The most frequent cause of hæmatemesis is an ulcer of the stomach. It occurs, according to the late Dr. Brinton, in about one-third of all the cases of gastric ulcer that come under treatment. The bleeding usually takes place shortly after a meal, and the quantity rejected varies greatly. In some cases, it is so small that it may require careful examination to discover it; whilst in

others enormous quantities are vomited, and often also passed through the bowels. The splenic artery is the source whence the bleeding most frequently proceeds, but it may arise from the coronary, the superior pyloric, or, more rarely, from the blood-vessels of some of the neighbouring organs, such as the pancreas, liver, or spleen, to which the stomach has become attached, and which may form the base of the ulcer. Although it is most apt to occur in chronic cases, instances have been recorded in which a large vessel had been laid open by an ulcer so small as to require careful search for its detection. It must be borne in mind that extensive bleedings may take place without any vomiting, and the source of the fatal illness be overlooked. Such cases are not of infrequent occurrence, and warn the practitioner that he should be on the alert whenever signs of hæmorrhage present themselves, and that he should not rely too much on the absence of pain and vomiting. In cancer of the stomach profuse hæmorrhage is less common than in simple ulcer; the larger vessels being probably compressed by the new-growth, which ordinarily commences in the submucous tissue immediately above them. But a constant oozing of blood is, on the contrary, more common than in simple ulceration. This blood, acted on by the gastric juice, constitutes the 'coffee-ground' vomiting of the older authors. Its occurrence used to be looked upon as pathognomonic of malignant disease, but it is now known that its presence only shows that the bleeding has taken place slowly and in small quantities at a time. Occasionally profuse hæmorrhage takes place from the rupture of an aneurysm into the stomach; and in a case which came under the writer's notice at the London Hospital, fatal vomiting of blood resulted from the perforation of the aorta by a fishbone that had become impacted in the œsophagus.

2. Congestion of the portal system is a very frequent cause of hæmatemesis. The most marked and fatal cases of this kind occur along with plugging of the vena portæ or its large branches with blood-clots or cancerous matter. Such cases are very rare, and vomiting of blood, from venous congestion, ordinarily results from cirrhosis, chronic congestion, and other diseases of the liver, in which the portal circulation is obstructed, and in which relief is obtained by communication with varicose œsophageal veins.[1] More rarely the like occurrence is observed in persons suffering from diseased heart, especially where there is narrowing of the mitral orifice. In such cases, there is generally a co-existence of chronic catarrhal gastritis, and in all probability the bleeding takes place from the hæmorrhagic erosions so common in that condition. In one form of this disease enormous quantities of mucus are discharged. Sometimes there is considerable bleeding in these cases, but they are distinguishable from ulcer by the absence of pain; by the vomiting being only occasional; and also by the fact that the blood-stained vomit generally follows a profuse evacuation of colourless mucus, and is always of a dark colour. In females thus affected the catamenial discharge is generally profuse; and the attacks of vomiting do not necessarily coincide with the menstrual periods. It has always been held that hæmatemesis may replace the menstrual discharge. Without denying this, the writer has never met with a well-marked case of the kind. Hæmatemesis due to acute congestion is also a constant result of irritant poisoning.

3. Hæmatemesis also arises from causes affecting the blood, and predisposing it to ooze through the walls of the veins or capillaries. It occurs in this way in purpura, yellow fever, and in some cases of typhus. In jaundice, where bleeding from the gums and other mucous membranes is so often observed, life may be suddenly destroyed by hæmatemesis. Occasionally a hæmorrhagic tendency manifests itself suddenly, without apparent cause, as in a case observed by the writer, in which a woman, about fifty years of age, was affected with severe bleeding from the nose, followed by excessive menstrual discharge, on the cessation of which profuse hæmatemesis took place, from which she sank. She had no jaundice nor other apparent cause for her illness, and after death the most careful scrutiny failed to detect disease in any organ. To this class of causes we should probably refer the hæmatemesis occurring in acute atrophy of the liver, and in pyæmia, as, in all probability, the oozing of blood through the vessels arises from changes effected in its chemical or physical composition.

Symptoms.—Generally the patient in hæmatemesis is suddenly attacked with faintness, accompanied by a feeling of weight at the pit of the stomach; the countenance is pale, the pulse feeble and compressible, and in some cases actual syncope occurs. This state terminates in vomiting, and a greater or less quantity of blood is rejected from the stomach. When a large blood-vessel has been laid open, and the bleeding has taken place rapidly, the blood may be florid; but generally the hæmorrhage goes on so slowly that time is given for the action of the gastric juice upon it, and consequently it is of a dark colour. It is not often that the stomach is completely emptied, or perhaps the bleeding persists in small quantities after the vomiting has ceased, so that the stools are generally of a dark or pitchy character, from the admixture of blood that has passed into the intestines. The hæmorrhage may cease soon after the stomach has been emptied, or the vomiting of blood may recur from time to time, or—and this is very apt to occur in gastric ulcer—months or years may elapse before it again takes place.

---

[1] See an instructive communication by Dr. Stacey Wilson, *Brit. Med. Journ.*, vol. ii. 1890.—Editor.

Diagnosis.—In some cases, when the blood has been slowly effused into the stomach, there may be difficulty in determining whether the dark colour arises from bile or blood. The microscope or spectroscope will be enough to settle this point; or the liquid may be boiled with alcohol, and tested for the biliary salts. It is not always easy to ascertain whether the blood has come from the lungs or from the stomach, as the patient is sometimes so much alarmed that he cannot say whether it was brought up by coughing or vomiting. As a general rule, the blood from the lungs is florid, mixed with mucus, alkaline, and frothy; that from the stomach of darker colour, acid, intermixed with particles of food, and in masses. Again, hæmoptysis is generally preceded by symptoms referable to heart or lungs, such as cough, expectoration, and dyspnœa; hæmatemesis by the symptoms indicative of gastric or hepatic disease, such as those described above.

Prognosis.—As a general rule this is favourable in hæmatemesis, more especially in first attacks. Dr. Brinton calculated that death resulted from this cause in only 3 to 5 per cent. of the cases of gastric ulcer; and it is still less frequently fatal where it proceeds from hepatic congestion or cirrhosis. Still, the possibility of the bleeding arising from an obstruction of the portal vein, from the opening of a large artery, or from the bursting of an aneurysm, should be kept in view, and the patient carefully watched.

Treatment.—Where a large quantity of blood has been ejected from the stomach, the treatment must be prompt and decided. The patient should be maintained in a recumbent posture, and kept perfectly quiet. All food must be forbidden, and pieces of ice placed in the mouth to suck. If faintness be present, it is better not to give brandy, which almost always brings on vomiting, but to apply ammonia to the nostrils; or, if necessary, an enema containing brandy may be given.

The best styptics are gallic acid, alum, and acetate of lead. The gallic acid may be given in 10-grain doses, along with 10 or 15 minims of diluted sulphuric acid, and should be repeated frequently. Alum may be prescribed in infusion of roses; and the acetate of lead in 2-grain doses in the shape of a pill, or combined with acetic acid. Oil of turpentine is also used. Where the bleeding is slight, and there is good reason to believe it arises from portal congestion, the best treatment is to give a small dose of calomel, followed by sulphate of magnesium and diluted sulphuric acid in infusion of roses every three or four hours, until purging is produced.

For some days after severe hæmatemesis strict quiet should be maintained. In the case of ulcer of the stomach, opium may be used. The diet should be most carefully regulated; if necessary, nutritive enemata should be substituted for food by the mouth, and all purgatives avoided. When portal congestion exists, a free action on the intestinal canal should be commenced after the cessation of the hæmorrhage, so as to diminish the amount of blood in the venous system of the alimentary organs.

S. Fenwick.

HÆMATHORAX.—*See* Hæmatothorax.

HÆMATIDROSIS (αἷμα, blood; and ἰδρῶς, sweat).—Bloody sweat. *See* Sudoriparous Glands, Disorders of.

HÆMATIN.—*See* Hæmoglobin.

HÆMATINURIA.—*See* Hæmoglobinuria.

HÆMATOBIUM (αἷμα, the blood; and βίος, life).—A synonym for hæmatozoon. *See* Hematozoa.

HÆMATOCELE (αἷμα, blood; and κήλη, a tumour).—Synon.: Fr. *Hématocèle*; Ger. *Blutgeschwulst*.

Definition.—A swelling occasioned by effusion of blood in the sac of the tunica vaginalis, or in a cyst connected with the testicle.

Ætiology and Symptoms.—The extravasation of blood in hæmatocele may take place in a healthy state of the parts, or it may succeed or be combined with hydrocele. In both cases it may be occasioned by a blow, or by violent efforts made in straining, especially in old persons, or when the blood-vessels are diseased. It may happen also from the accidental wound of a vessel in tapping a hydrocele; or, without any such wound, a hæmatocele may supervene if the walls of the sac are very vascular, and a vessel, lacking the pressure of the hydrocele fluid, gives way. The blood effused, if small in quantity, mixes with the fluid of the hydrocele, and occasions slight enlargement without disturbance. If it be large in quantity, coagula are formed; inflammation is excited in the tunica vaginalis; and plastic exudation occurs on its inner surface, sometimes forming layers, and rendering the sac extremely dense and firm.

The testicle preserves the same relation to the remainder of the tumour as in hydrocele, being situated at its posterior part. Its position, however, is liable to similar alterations as occur in hydrocele, which are very difficult of detection, owing to the great thickening of the parts.

Diagnosis.—A hæmatocele may be distinguished from a hydrocele by the absence of transparency; the obscure character of the fluctuation; the heavy feel of the tumour when balanced in the hand; and the sudden and accidental mode of its occurrence. In old chronic cases, in which the tunica vaginalis and its envelopes have become much thickened and indurated, the tumour possesses so firm a character, and feels so heavy and solid, that it is very liable to be mistaken for a chronic enlargement of the testicle; and the diagnosis, at all times difficult, in some instances cannot be satisfactorily made out by the most experienced hands. The records of surgery furnish many cases in which castration has been performed owing to a mistaken diagnosis. When doubt exists, it should be removed by the introduction of a trocar or by an incision before any serious operation, such as castration, is undertaken.

Treatment.—When hæmatocele succeeds a hydrocele, the blood, if small in quantity, mixes with the fluid of the hydrocele without producing irritation. The tinged fluid may be removed by tapping, and the operation can be repeated afterwards at intervals until the fluid is free from discoloration. Even when inflammation arises, if the sac be tapped and tension removed, and the patient be kept at rest, with ice applied to the part, the inflammation may subside. When, however, the blood effused is large in quantity, and when the inflammation is acute and threatens suppuration, the tumour should be punctured at its upper part, a director introduced, and the sac freely laid open by incision. This must be done with care, so as to avoid wounding the testicle. A chronic hæmatocele with a very thickened sac must be cut into in the same way; and lateral portions of the sac may be excised, so as to lessen the wound for healing. If from old age, or other causes, the patient's general condition be unfavourable for excision, castration may be requisite. The practitioner must bear in mind that the testicle is sometimes situated in front, as in cases of inversion, and is then very liable to injury in the operation of incision, and even in tapping.

Encysted Hæmatocele.—Encysted hæmatocele implies an effusion of blood in the sac of an encysted hydrocele. The treatment is the same as that required for ordinary hæmatocele.

Hæmatocele of the Cord.—Blood may also be effused in the areolar tissue of the spermatic cord, constituting *diffused* hæmatocele of the cord; or in a cyst in the cord, constituting *encysted* hæmatocele of the cord. Such cases are very rare.

T. B. Curling. J. McCarthy.

HÆMATOIDIN.—*See* Hæmoglobin.

HÆMATOMA (αἱματόω, I fill with blood).—A peculiar form of bloody tumour, or a collection of extravasated blood that has undergone certain changes. It is observed more especially in connexion with the ear, the vagina, the scalp, and the meninges. *See* Cephalhæmatoma; Hæmatoma Auris; Meninges, Cerebral, Hæmatoma of; Fungus Hæmatodes; and Tumours.

HÆMATOMA AURIS (αἱματόω, I fill with blood; *auris*, of the ear).—Synon.: The Insane Ear; Fr. *Othématome*; *Hématome de l'Oreille des Aliénés*; Ger. *Othämatoma*; *Ohrblutgeschwulst von Geisteskranken.*

Definition.—An affection of the auricle, which occurs almost, if not quite exclusively, in the insane, and consists in the effusion of blood or bloody serum between the cartilage and its perichondrium, to such an extent as to form a distinct tumour.

Ætiology.—In most of the few cases of hæmatoma auris which have been published to show that this disease may occur in the sane, the description given of the patients rather points to their insanity than otherwise. It is most common in cases of general paralysis and mania (acute and chronic), but also occurs in melancholia, dementia, and idiocy. It is about four times as frequent in men as in women; and more often affects the left ear than the right. Sometimes both ears are affected, but seldom at the same time. There would seem to be, in many or all of the insane, a morbid condition of the vessels or other tissues of the auricle, which predisposes to the occurrence of hæmatoma. If this condition be present to a sufficient degree, the disease may arise spontaneously; in other cases a very slight injury may be sufficient to cause it; whilst in others very considerable violence is necessary for its production.

Symptoms and Course.—The disease first makes itself evident by the appearance of a swelling of about the size of a horse-bean; this is almost always upon the anterior surface of the pinna, and usually in the neighbourhood of the fossa of the antihelix. The skin over the tumour is generally of a reddish or bluish-red colour, but may be unaltered at first; the temperature of the ear is sensibly raised; the swelling is very painful and tender; there is no extravasation of blood from the cutaneous vessels; and the tumour is not œdematous. At this stage, the effusion which has taken place between the cartilage and its perichondrium consists of dark-red fluid blood. In rare cases the swelling does not increase further; the inflammatory symptoms subside after about a week; absorption gradually takes place; and only a slight thickening remains. More usually the tumour increases and may attain the size of a hen's egg; it becomes tense, elastic, distinctly fluctuating, and hot; and is often of a bright red colour. Its prominent anterior wall, consisting of skin, cellular tissue, and perichondrium, is felt to be thinner and less resisting than the posterior, which contains the ear-cartilage. In certain cases, however, owing to the brittle cartilage having split up, and portions of it having adhered to either wall, both walls present irregularly alternating characters. The time which a hæmatoma takes to attain its largest size varies from a week to a month; it then generally involves the whole of the concha, occluding the external auditory meatus; the folds of the auricle are lost, with the exception of the helix (which appears as a band running round the tumour) and the dependent lobule. The weight of the tumour causes the whole ear to fall somewhat forwards and outwards. Sometimes, especially in the presence of constant or repeated irritation, the inflammatory stage may last many weeks, and the deformity which always results from the affection is thereby greatly increased. Unless subjected to violence, it very rarely happens that the tumour opens spontaneously, although its tense and inflamed appearance often seems to indicate that such an occurrence is imminent. If rupture does take place, suppuration ensues; portions of cartilage come away; the cavity closes very slowly; and great deformity results. The most common course is for the inflammatory symptoms gradually to subside. The anterior wall becomes firmer, owing to a new deposit of cartilage upon its inner surface; the sense of fluctuation is gradually lost; and the tumour slowly diminishes in size, often yielding a somewhat doughy sensation to the touch. Occasionally, at this stage, some gaseous contents have been observed in the cavity. The colour of the skin over the tumour becomes gradually more dusky; it then passes into yellow and, later on, into an unnatural pallor. As the fluid contents become absorbed, the tumour becomes harder and smaller; folds again appear in the auricle, but do not correspond to the original ones; and the pinna remains permanently thickened, puckered, and often nodular.

Anatomical Characters.—Many of these have been given above in explanation of symptoms, and do not require to be repeated. A shrivelled auricle, which has previously been affected by hæmatoma, presents, on section, two distinct layers of cartilage; these are of varying thickness, and separated from each other by vascular fibrous tissue, which often contains within it other small isolated plates of cartilage, and sometimes also small portions of bone. The fibrous tissue is the organised product of the original effusion. The two layers of cartilage have been developed upon the inner surfaces of the perichondrium. The loose portions of cartilage and bone which are occasionally seen, are developed from the fibrous tissue. It used to be supposed that the bone (which is soft, vascular, and contains well-developed Haversian systems) resulted from ossification of the ear-cartilage; but the writer has shown elsewhere (*Brit. Med. Journ.*, Oct. 1873) that this is not the case.

Prognosis.—The local affection is in no way dangerous, but it always leaves behind it a permanent characteristic deformity of the auricle. The sense of hearing is only affected by the occlusion of the auditory meatus; but this condition very rarely persists after the acute stage. The occurrence of hæmatoma auris influences the prognosis of the mental disease unfavourably, but does not necessarily indicate the approach of a fatal termination to the case.

Treatment.—Protection of the part from injury is usually all that is necessary. Cooling applications are useful when the inflammation is excessive. The tumour should not be opened; nor should a portion of the anterior wall be removed, as has been recommended; these procedures only lead to suppuration. It is useless to empty the cavity by aspiration, as it fills again with great rapidity. The treatment by pressure is very painful, and yields no good result.

Chas. S. W. Cobbold.

HÆMATO-PERICARDIUM (αἷμα, blood; περὶ, about; and καρδία, the heart).—An extravasation of blood into the sac of the pericardium. *See* Pericardium, Diseases of.

HÆMATO-THORAX (αἷμα, blood; and θώραξ, the chest).—An extravasation of blood into the pleural cavity. *See* Pleura, Diseases of.

HÆMATOZOA (αἷμα, blood; and ζῶον, an animal).—This term is of general application to all kinds of animal parasites dwelling in the blood and blood-vessels; but its employment is often restricted to certain of the nematoid entozoa which display this habit in a more marked degree than the other parasites are wont to do. All classes of helminths are liable, at some time or other in the course of their lifetime, to take up their residence in the blood, but in the case of the *Tæniæ*, or rather of their *proscolices*, this period is of very short duration. One or two species only of fluke-worms or trematodes play a similar *rôle* in man, the most important being the *Bilharzia*, which gives rise to an endemic hæmaturia at the Cape, and elsewhere in Africa (*see* Bilharzia). Our knowledge of the nematoid hæmatozoa dates at least as far back as the time of Ruysch (1665), who was acquainted with the strongyles which produce aneurysm in the horse and other solipeds; whilst more than half a century later the subject received additions from the writings of Schulze (1725) and Chabert (1782); and subsequently from the memoir by Rayer (1843). About the latter period also the observations by Grube and Delafond 'on a verminiferous condition of the blood of dogs, caused by a great number of hæmatozoa of the genus *Filaria*,' excited much attention; but until quite recently it was not so much as suspected that similar microscopic filariæ infested the human body. In 1872 the late Dr. Lewis announced the important discovery of the existence of nematoid worms in the living human subject also. *See* CHYLURIA; and FILARIA SANGUINIS HOMINIS. T. S. COBBOLD.

HÆMATURIA (*αἷμα*, blood; and *οὖρον*, urine).—SYNON.: Fr. *Hématurie*; Ger. *Blutharnen*.

DESCRIPTION.—Hæmaturia is a symptom of many different morbid conditions of the system, and of the urinary tract. The quantity of blood discharged in the urine varies greatly, and the appearance of the urine corresponds. Sometimes it is dark, loaded with clots; sometimes it is merely smoky, or of a faintly pink hue. It is always albuminous, and corpuscles (often altered by the action of the urine) may be discovered by the microscope, sometimes becoming swollen, sometimes shrunken. The following are the best tests for detecting the presence of blood in the urine: (1) *Guaiacum*. When equal parts of simple tincture of guaiacum and oil of turpentine are shaken together to make an emulsion, and the urine is cautiously added, an intense blue colour is produced if blood be present. (2) *Spectrum analysis*. Very minute quantities of blood in the urine show absorption-lines between Frauenhofer's lines D and E in the yellow and green of the spectrum. *See* SPECTROSCOPE IN MEDICINE.

The blood in hæmaturia may be derived from the urethra. If so, it precedes the stream of urine, sometimes forms a long thin clot, and may escape in the intervals of micturition. Sometimes it is derived from the prostate gland or the bladder. When it has lain in the bladder and been poured out in considerable quantity, it is often in clots; and when the urine is voided, the first part is frequently clear, the last loaded with blood. Blood may also be derived from the ureter or the pelvis of the kidney. Sometimes clots in the form of moulds of these structures may be recognised. At other times the blood is derived from the substance of the kidney, and then is intimately mixed up with the urine, which frequently exhibits blood casts of the tubes.

ÆTIOLOGY AND PATHOLOGY. — Urethral hæmorrhage is due to local inflammation or rupture of vessels or to calculus. Prostatic hæmorrhage may be due to tumours, malignant or otherwise, to inflammation, or to scrofulous affection of that organ. Vesical hæmorrhage results from malignant disease, from simple villous growth, inflammation, ulceration, tubercular disease, or the irritation of a calculus. Hæmorrhage from the ureters or pelvis of the kidney may be due to the presence of calculi, or to other causes. Hæmorrhage from the kidney may be due to malignant disease, tubercle, suppurative nephritis, or to the irritation of crystals or amorphous concretions within the uriniferous tubules. Hæmorrhage occurs also in all the forms of Bright's disease, especially in the early stage of the inflammatory form, and the advanced stage of the cirrhotic. It results from over-doses of turpentine, chlorate of potassium, and cantharides, and from rupture of the kidney. Sometimes it is a manifestation of purpura hæmorrhagica, more rarely of scorbutus; occasionally it occurs in the course of, or as a sequel to, eruptive or continued fevers. It is also occasionally vicarious. Renal hæmorrhage occurs in Egypt, Mauritius, and other localities, in consequence of the existence of a minute parasite, the Bilharzia hæmatobia. *See* ENTOZOA; CHYLURIA.

TREATMENT.—The treatment of hæmaturia must vary according to the lesion to which the hæmorrhage is due. But where the symptom is so urgent as to demand treatment for itself, the most important points to be attended to are rest, free relief of the bowels, and the application of ice-bags over the source of the hæmorrhage; along with the internal administration of astringents, especially gallic acid, ergot of rye, perchloride or pernitrate of iron, turpentine, or acetate of lead, with or without opium. If these do not succeed, the subcutaneous injection of ergotine is often efficacious. Surgical interference may be required for relief of symptoms due to coagula.

T. GRAINGER STEWART.

HÆMIC ASTHMA.—A form of asthma, dependent upon an abnormal condition of the blood. *See* ASTHMA.

HÆMIC MURMUR.—A murmur connected with an abnormal condition of the blood, as in anæmia. *See* ANÆMIA; and PHYSICAL EXAMINATION.

HÆMIN.—*See* HÆMOGLOBIN.

HÆMOGLOBIN (*αἷμα*, blood; and *globus*, a ball).—SYNON.: Hæmatoglobulin.—This substance, the most important pigment in the body, occurs in the red blood-corpuscles, of which, when dried, it forms 90 per cent., this representing 13 to 14 per cent. of ordinary blood. In the corpuscles the hæmoglobin infiltrates the colourless proteid stroma, from which it may be extracted by water, ether, chloroform, or bile salts, thus forming a solution in the plasma; blood so treated is termed 'laky.' It is of an extremely complex nature, its percentage composition in the dog being estimated at C 53·85, H 7·32, N 16·17, O 21·84, S ·39, F ·43. It is to be regarded as a compound of a proteid substance—globin, and a coloured body—hæmatin, which contains all the iron of the molecule. The former belongs to the globulin group, though its exact nature is not known; and the latter, as a constituent of hæmoglobin, appears to differ slightly from the separated hæmatin presently described. The precise character of the association of these two substances in the compound, whether a simple mixture or a chemical combination, is as yet undetermined.

Hæmoglobin presents a singular exception to the general law of diffusion, inasmuch as, though it crystallises, it will scarcely diffuse through membrane. A considerable variety in the shape of the crystals is met with in different animals, and much difference in the facility with which it crystallises; in man they occur as elongated prisms, and are formed with difficulty.

The most important property of this compound is its affinity for oxygen. In some obscure manner this gas enters into a loose combination with hæmoglobin in the lungs, forming *oxy-hæmoglobin*, and is then conveyed by the red corpuscles throughout the body, separating again from its conveyer in the tissues. The hæmoglobin thus deprived of its oxygen is known as *reduced hæmoglobin*, and is of a purplish colour, whilst the oxy-hæmoglobin is of a scarlet tint. It is thus that the difference in colour between arterial and venous blood is mainly to be accounted for. The spectra of these two kinds of hæmoglobin are characteristic, that of the former being distinguished by two absorption bands of unequal width and intensity between the solar lines D and E (*i.e.* in the yellow and green region of the spectrum), whilst the reduced hæmoglobin presents but a single band occupying a position between the two of the oxidised form. It is to be noted that, whatever be the nature of the combination that exists between the oxygen and its carrier, it is such that the gas retains its properties as a gas, and the union may be roughly compared to a mere solution of the gas in a fluid. There is reason to believe that the oxygen-carrying power is mainly, if not entirely, possessed by the hæmatin constituent, since this substance is capable of being oxidised and reduced in a manner similar to hæmoglobin itself; and, further, this capability is closely dependent on the presence of the iron —iron-free hæmatin having no such power. The 'respiratory pigment' corresponding to hæmoglobin in some of the invertebrata contains copper in place of iron.

Another compound of this substance with oxygen, in which the gas is much more closely combined, is termed *methæmoglobin*; and a still more stable association takes place between hæmoglobin and carbonic oxide, which thus produces its rapidly poisonous effect by preventing the oxygen-carrying power of the blood. Nitric oxide behaves in a similar fashion.

Certain variations, both quantitative and qualitative, are recognised in disease, but our knowledge in this direction is most fragmentary. In anæmia the amount of hæmoglobin is frequently diminished by a half, and in extreme cases to even less than a quarter of the normal.

The hæmoglobin may be liberated from the stroma of the corpuscles and dissolved in the blood-plasma (hæmoglobinæmia), finally appearing in the urine (hæmoglobinuria), though chiefly in the form of methæmoglobin. This result frequently follows on poisoning by arseniuretted hydrogen, phosphorus, carbolic and some of the mineral acids; also in the course of typhus fever, pyæmia, and scurvy, or after severe burns, and in some cases of jaundice. It is probable that coincident changes in the vascular endothelium favour the diffusion of the pigment.

It is further stated that, in some septic states, pyæmia, cancrum oris, and erysipelas, and also in leukæmia, the blood when drawn from the body shows a remarkable tendency to crystallise, quite contrary to the normal. This has been attributed to the presence in the blood of some peculiar ferment.

The chief derivatives of hæmoglobin may now be briefly referred to.

(*a*) **Hæmatin**($C_{32}H_{32}N_4FeO_4$).—Hæmatin may be obtained from red blood-corpuscles by treatment with acids or with strong alkalis.

It is an amorphous dark-brown powder, insoluble in water, alcohol, or ether, but readily soluble in caustic alkalis, in sulphuric or acetic acids, and in chloroform. The acid and alkaline solutions each give a characteristic spectrum. The acid hæmatin is known as hæmatoin. A solution gives a characteristic absorption-band in the spectrum, different from those produced by hæmoglobin. It forms a green solution when boiled with caustic potash.

(*b*) **Hæmin** ($C_{32}H_{31}ClN_4FeO_3$).—Hæmin, which may be prepared from dried hæmoglobin by treatment with glacial acetic acid, in the presence of an alkaline chloride, is a hydrochloride of hæmatin. It crystallises tolerably readily in needle-shaped prisms or rhombic plates, and thus becomes an easy means of detecting the presence of blood in stains of a doubtful nature. The crystals are insoluble in water, alcohol, chloroform, and ether, and soluble in caustic alkalis and boiling hydrochloric and acetic acids.

(*c*) **Hæmatoidin** ($C_{32}H_{36}N_4O_6$). — This substance is one of the forms of iron-free hæmatin of natural occurrence as rhombic prisms or needles of a red or greenish-red colour; a fact which shows that the colour of hæmoglobin is not dependent on the iron. It is of considerable pathological interest, being frequently found in old clots, and in the cavity of ruptured Graafian follicles. It is the cause also of the staining so often seen in the neighbourhood of extravasations of blood, varying from lemon-yellow up to reddish black.

(*d*) **Hæmatoporphyrin,** also containing no iron, and probably isomeric with the foregoing, may be prepared from hæmatin by heating with fuming hydrochloric acid.

The relationship of hæmoglobin, hæmatin, hæmatoidin, and hæmin to the pigments of the body is of the greatest interest. It would seem that the hæmoglobin is the source of all—biliary, urinary, &c. A constant destruction of red corpuscles is taking place in the spleen, and probably also in the bone-marrow. The hæmoglobin which is liberated from the stroma reaches the liver, where the globin is separated, the iron removed, and bilirubin formed. Normal urobilin, the chief colouring-matter of the urine, is very similar to bilirubin, and is derived from that substance or directly from hæmatin or hæmoglobin itself. The pigments of the bile, fæces, and urine are therefore to be regarded as the excreted waste of hæmoglobin. Bilirubin is closely allied to, if not identical with, hæmatoidin; and a play of colours—the result of oxidation—may be obtained from the latter when treated with nitric acid, similar to that produced by the bile-pigments under the same condition. The injection of hæmoglobin into the blood is followed by the presence of bile-pigments in the urine, and an increase of bilirubin in the bile. Melanin, the black pigment of the retina, hair, and skin, and often found in connexion with new-growths, especially with those of a malignant character, also appears to be directly drawn from hæmoglobin. The colouring-matter of the blood is certainly associated, in some way other than that of its oxygen-carrying function, with the nutrition of the tissues, in connexion with the obscure but unquestionable influence of pigments. W. H. Allchin.

HÆMOGLOBINOMETER (Hæmoglobin; and *μέτρον*, a measure).

Definition.—An instrument for the clinical estimation of the amount of hæmoglobin in blood.

Description.—The quantity of hæmoglobin may be ascertained by estimating the amount of iron in the blood, or by observing the dilution necessary to obscure a certain absorption-band in the spectrum (*see* Spectroscope in Medicine). Neither of these methods is, however, available for clinical use. Simpler methods have therefore been contrived, which depend on a comparison of the colour of diluted blood with that of solutions of carmine and picro-carmine. By this combination the tint of blood, and even its spectrum, may nearly be obtained (Malassez). Coloured discs have been employed for the same purpose (Hayem). In these methods a given dilution of blood is made, and this is compared with the tint of the standards. In the hæmoglobinometer designed by the writer (and made by Hawksley) the blood is progressively diluted until it reaches the tint of a standard, the colour of which corresponds to a dilution of 1 part of healthy blood in 100 of water. The degree of dilution necessary to make the two correspond represents the amount of hæmoglobin. The apparatus consists of two tubes of exactly equal diameter, and a capillary pipette, holding 20 cubic mm., for measuring the blood. One tube is filled with a standard, consisting of glycerine jelly coloured to the required tint. The other is graduated, each division being equal to the volume of blood taken (20 cubic mm.), so that 100 divisions equal 100 times the volume of blood. The dilution is made by a pipette stopper, and distilled water; the number of degrees of dilution necessary to produce correspondence with the standard indicates the percentage proportion of the hæmoglobin of the blood examined compared with normal blood. For example, the blood of a patient, being progressively diluted, is found to reach the tint of the standard when the amount of water added corresponds to 45 degrees of dilution; the blood examined therefore contains 45 per cent. of the normal quantity of hæmoglobin. The method is no doubt 'rough,' but it is quick and easy. With care there should not be more than 5 per cent. of error. It is well to note not only the point at which the tints become similar, but the number of degrees of dilution through which they appear alike, and to take the mean. The result, being a percentage, is immediately applicable to that obtained with the hæmacytometer. *See* Hæmacytometer.

W. R. Gowers.

HÆMOGLOBINURIA (Hæmoglobin; and *οὖρον*, the urine).—Synon.: Hæmatinuria.

Definition.—A morbid condition of the urine resulting from disintegration of blood-corpuscles, characterised by change of colour of the secretion, in consequence of the presence of granular *débris* containing a large proportion of hæmoglobin; sometimes paroxysmal; sometimes a result of the action of poisons; and sometimes associated with other more dangerous symptoms, and tending to a fatal result.

Ætiology.—Hæmoglobinuria is not referable to any structural change in the kidneys. It is a result of morbid action in the blood, consisting essentially in the disintegration of the red corpuscles, whereby the hæmoglobin is set free. It has been observed in the course of fevers, particularly ague and scarlatina, also as a result of insolation, and, in the paroxysmal cases, as a result of chill. Outbreaks of this disease have been described as attacking newly born infants. In that described by Winckel of Dresden, in 1879, twenty-four cases occurred, and twenty-three proved fatal. This was evidently due to the action of a specific poison existing in the Maternity Hospital at the time. Cohnheim also showed that it occurred as a result of severe, but not speedily fatal, burns. Transfusion of the blood of one kind of animal into the veins of another may suffice to produce it. Moreover, many poisons have been found to induce the condition. By far the most important of these is chlorate of potassium. In the case of children, one to two drachms in the twenty-four hours is a dangerous quantity; in the adult, three drachms or upwards. Next to it, but at a long interval, rank carbolic, hydrochloric, sulphuric, and pyrogallic acids, and the inhalation of arseniuretted hydrogen gas. In what way we are to explain the action of these various substances upon the blood-discs is as yet far from clear, but the fact that they do so act is fully established.

Morbid Anatomy. — The kidneys are throughout of a deep chocolate colour, with radiating striæ of a darker tint. The sections show under a low power dark lines corresponding to the tubules, and spots marking the Malpighian bodies. With a higher power one makes out that the tubules are blocked with granular pigment, and that this discharge is evidently from the Malpighian tufts. There are sometimes alterations in the spleen and in the bones, and hæmorrhages into various tissues.

Symptoms.—The chief clinical features of hæmoglobinuria are those referable to the urine. It is dark like porter, or like the sediment of port-wine ; sometimes brown like coffee, or almost black. This colour is due mainly to hæmoglobin, and usually few, if any, blood-corpuscles are present. Tube-casts and oxalate-of-lime crystals are often present in large numbers. The urine coagulates on heating, or on the addition of nitric acid. Spectroscopically examined, it shows the features characteristic of hæmoglobin, oxyhæmoglobin, and methæmoglobin. Otherwise the patient shows tokens of general discomfort ; gastro-intestinal disturbance ; jaundice more or less pronounced ; sometimes enlargement of spleen, and subcutaneous hæmorrhages ; weakness of heart ; tendency to hypostatic congestion in cases of a bad type ; with other symptoms of depression or even collapse.

Diagnosis.—The different forms of hæmoglobinuria have to be diagnosed from each other, and from certain diseases which resemble the paroxysmal forms. *See* Hæmoglobinuria, Paroxysmal.

Prognosis.—Cases of this kind rarely terminate unfavourably except when hæmoglobinuria is merely one of many symptoms in connexion with blood-poisoning.

Treatment. — Protection against septic processes or other causes is of the first importance. When the symptom is developed, ferruginous tonics and chloride of ammonium may be tried. T. Grainger Stewart.

HÆMOGLOBINURIA, PAROXYSMAL.—Synon. : Paroxysmal Hæmatinuria.

Definition.—A paroxysmal affection of the system ; manifesting itself by changes in the urine, and particularly the discharge of hæmoglobin ; caused sometimes by malaria, and sometimes by other conditions not yet determined ; consisting in no anatomical change as yet recognised ; and characterised by the occasional occurrence of constitutional disturbance, with discharge of dark, blood-stained urine.

Ætiology.—The most important extrinsic cause of the tendency to this disease is malarious poison ; the most important cause of the paroxysm is exposure to cold or wet ; but the tendency may exist without malarial poison, and the attack may occur apart from any special exposure. Amongst intrinsic causes, sex is evidently important, for the disease is almost confined to males. It may occur in children, and may occasionally recur during a period of years.

As in other forms of hæmoglobinuria, the symptom is traceable to disintegration of red corpuscles within the circulating fluid. That this may occur locally has been proved experimentally by Ehrlich. He tied a ligature round the finger of a patient who was liable to the disease, and then chilled the congested part by immersing it for a quarter of an hour in ice-cold water, afterwards transferring it for a like period to tepid water. In this patient it was found that many corpuscles were broken down, while no such effect was produced elsewhere in the body or in healthy people. It is probable, however, that it is chiefly in the liver that the destruction of corpuscles ordinarily takes place ; and it is uncertain whether it results from a direct influence operating upon the corpuscles, or through the production of some chemical substance and its action upon them.

Anatomical Characters.—The disease not being fatal, there is no evidence as to the existence of any anatomical change in the kidneys, but there is every reason to suppose that if the kidneys were examined they would show the appearances met with in non-paroxysmal hæmoglobinuria.

Symptoms.—This form of hæmoglobinuria is paroxysmal, but not distinctly periodic. It may commence in childhood or during adult life. The attacks may occur once, twice, or thrice a day, on alternate days, once a week, or quite irregularly. The paroxysm may commence abruptly without any premonitory symptom, but is more commonly ushered in by a feeling of uneasiness in the loins and limbs, by shivering, and general chilliness. Sometimes it is preceded by slight jaundice, furred tongue, and other symptoms of gastric catarrh; and sometimes albuminuria precedes by a few hours or a day the occurrence of hæmoglobinuria. The more abrupt attacks frequently terminate by the discharge of the peculiar urine, the uneasy feelings having subsided before it recurs; and the next urine is normal, or nearly so. In some cases albuminuria precedes or lingers for a time after the discoloration has passed off, and sometimes it replaces the hæmoglobinuria. *See* Bright's Disease.

The characters of the urine are very peculiar. Its colour is like porter, or like muddy port-wine; its specific gravity ranges from 1015 to 1035; it is acid, or faintly alkaline; it is highly albuminous; sometimes it contains excess of urea. It throws down a copious sediment, which contains very few or no blood-corpuscles, but an immense amount of granular blood-pigment, with numerous tube-casts—hyaline or epithelial, often loaded or coated with amorphous granular matter, and with minute crystals of oxalate of lime. The colour is not due to blood-corpuscles, nor to hæmatin, but to hæmoglobin. In some cases the urine is less affected, being merely albuminous, and not depositing pigment. It may be doubted whether this condition should be admitted to the same category as the disease under discussion, but cases which have come under the writer's observation seem to show that it is entitled so to rank, and it is dealt with in the article just referred to.

A very interesting point in the clinical history of hæmoglobinuria is its relationship to Raynaud's disease. The relationship is neither constant nor exclusive, and the precise link which connects them is as yet not clearly determined. Still the clinical fact remains, that when the one disease exists the other is not infrequently present.

Diagnosis.—The only diseases with which intermittent hæmoglobinuria is likely to be confounded are hæmaturia, and renal calculus or gravel. From the former it is distinguished by the abundance of the blood-pigment and the extreme rarity of blood-corpuscles; from the latter, by the short duration of the attacks, the presence of the characteristic deposit, with the fact that the pains affect both loins, not merely one. It is sometimes important to distinguish the milder forms, in which merely albuminuria occurs, from congestion or from commencing inflammatory Bright's disease. It is not always possible to distinguish these during the early hours of the attack; but the amount of general disturbance, the state of the tongue, the slight jaundice, the suddenness of the onset, and the absence of dropsy, generally suffice to make the diagnosis clear.

Prognosis.—The prognosis is good in paroxysmal hæmoglobinuria, as to the individual paroxysm. The tendency to the disease is also not infrequently got rid of. It has not proved fatal in any case. But it appears sometimes to usher in, or to constitute an early symptom of, Bright's disease—the cirrhotic form.

Treatment.—With a view to preventing the attacks, individuals who are subject to paroxysmal hæmoglobinuria should carefully avoid exposure to cold and over-fatigue of every kind. They should take abundance of good and easily digested food, should avoid free use of alcohol, and should clothe warmly. As the paroxysm is spontaneously recovered from, little need be done, excepting with the view of alleviating the discomfort of the patient. He should go to bed and be kept warm, and have abundance of warm drinks. In respect of diminishing or removing the tendency to the malady, various remedies have been found useful, among which may be mentioned quinine, tincture of cinchona, iron, arsenic, and chloride of ammonium. Antisyphilitic treatment by means of mercury has also been found useful.

T. Grainger Stewart.

HÆMOPERICARDIUM.—*See* Hæmato-pericardium.

HÆMOPHILIA (*αἷμα*, blood; and *φιλία*, predisposition for).—Synon.: Hæmorrhaphilia; Hæmorrhagic Diathesis; Bleeders; Fr. *Hémophilie*; Ger. *Bluterkrankheit.*

Definition.—A congenital disease, often hereditary, characterised by a tendency to immoderate bleedings, whether spontaneous or traumatic, and to obstinate swellings of the joints.

Ætiology.—Men are far more liable than women to this disease; the proportion being about eleven to one. Women who suffer from hæmophilia show much less typical specimens of the disease than men, and rarely die from hæmorrhage, although floodings and profuse menstruation are common.

The best-ascertained cause of hæmophilia is hereditary predisposition. No other cause is known with anything like certainty. In a bleeder family, the disease descends to the boys through the mothers, the women remaining quite healthy and apparently free from all disease. The fathers do not seem to transmit the disease to their sons; at least, instances of this are rare. The women of bleeder families are remarkably fertile. Some have thought hæmophilia to be more common in Germany, but this is probably owing to the greater attention paid to the disease in that country. Cases have been met with in the Indian Archipelago, North America, the Scandinavian kingdoms, and elsewhere. The disease is not limited to the Aryan races, as the Jews, a Semitic nation, are singularly liable to it.

Anatomical Characters.—No morbid appearances have yet been found after death with any constancy. The blood-vessels are apparently unaltered. The condition of the blood has not yet been properly investigated. It would be important to ascertain whether the number of white corpuscles is increased or diminished, and whether they are altered in character. The swellings of the joints appear to be due to the extravasation of blood within the articulation.

Symptoms.—The first signs of hæmophilia are commonly seen during the first year of life; but sometimes they are delayed until the beginning of the second dentition. Cases on record of a much later appearance of the first symptoms are not trustworthy. It is very rare for bleedings to be noticed at birth. There is nothing about the subjects of hæmophilia, when not suffering from bleeding, to distinguish them from ordinary persons. They look well; and nothing amiss can be discovered by physical examination in chest or belly.

There are three well-marked *degrees* of hæmophilia. The first is the most typical and characteristic, in which there is a tendency to every kind of hæmorrhage, traumatic or spontaneous, interstitial or superficial. The swelling of the joints is well-marked. This degree is scarcely ever seen in women; but it is the most common among men. In the second degree, spontaneous hæmorrhages from the mucous membranes only are present. The third degree, in which the tendency is little marked, is seen only amongst the women of bleeder families; and shows itself only by spontaneous ecchymoses.

Hæmorrhage.—Spontaneous bleedings are sometimes preceded by symptoms of unusual fulness and plethora. The mucous membranes supply the blood in this case; in childhood bleeding from the nose is the most common, and also the most fatal, although bleedings from the bowel, mouth, or chest may also occur. There is only one known instance of death from hæmaturia. The traumatic bleedings vary much in intensity, even in the same individual. Death has followed division of the frænum of the tongue, vaccination, leeching, and the extraction of a tooth. This last is a very common cause of death. If abscesses be opened, furious bleeding commonly takes place; and the same occurs if a blood-tumour or extravasation of blood be interfered with.

The bleeding is nearly always capillary, and may kill in a few hours or after some weeks. The quantity of blood lost is sometimes enormous. After the bleeding the patients are extremely anæmic; and this state may last for months.

Besides superficial bleedings, interstitial hæmorrhages, ecchymoses, and blood-tumours may be observed, whether spontaneous or traumatic. A bruise which a healthy person would not feel may fill the connective tissue of a limb with blood; or the bleeding may be circumscribed, and form a tumour instead.

Swelling of the joints.—This chiefly affects the larger joints, the knee being most commonly attacked. The joint, most commonly after some injury, becomes swollen and painful, and apparently filled with fluid; there is fever; and this state may last for many weeks. Relapses are very apt to occur during convalescence.

Diagnosis.—The diagnosis of hæmophilia is often easy. If a boy have suffered repeatedly from early infancy from abundant bleedings—especially traumatic—and from joint-affections, there can be no doubt of the diagnosis. It is made more certain by the existence of hereditary predisposition. In women the diagnosis must be made with more care, as they are subject to a hæmorrhagic disorder which first appears about puberty, but which is not hereditary.

Prognosis.—The prognosis is not so serious with respect to life as was formerly thought.

Treatment.—The treatment of hæmophilia includes almost the whole subject of the treatment of hæmorrhage. Surgical interference in the way of the ligature of arteries is, however, contra-indicated in connexion with hæmophilia, as the hæmorrhage in such cases is almost exclusively capillary. For the same reason, the administration of ergot, with a view to bringing about a contraction of the arterioles, would not be likely to prove of service. Treatment ought to be directed entirely to bringing about an increase in (*a*) the rapidity of coagulation, and (*b*) in the firmness of the resulting clot. In our present ignorance on the subject of the pathology of hæmophilia, treatment must take cognisance of every factor which is known to influence the coagulability of the blood. The facts that have been ascertained in connexion with this subject are as follows: A defect in coagulability may depend on one or other of the following conditions:—

A Defect in the Inorganic Substratum of Fibrin.—This may consist in a diminution of the amount of available calcium salts in the blood. Defective coagulation arising from this cause is to be met by the administration of lime-salts, preferably calcium chloride (liquor calcii chloridi B.P., 1 oz. to 1½ oz. for an adult; in ½ to 1 pint of water). Owing to the disagreeable taste of the salt, it is best administered in the form of an enema. A 1 per cent. solution of calcium chloride may also be applied as a local styptic. Stronger solutions are not to be recommended, as coagulation is retarded after a certain percentage of calcium has been exceeded. In view of the fact that the action of the lime-salt is not instantaneous, the solution must be applied on a tampon in such a manner as to hinder the flowing away of the blood with which it comes in contact. In all cases the clots obtained by the addition of lime to the blood are characterised by an extraordinary firmness. The coagulative efficacy of a solution of lime-salts can be increased by the addition of fibrin ferment. This last can be obtained by extracting washed fibrin with water.

A Defect in the Organic Substratum of Fibrin.—There is little doubt that the coagulation of the blood is brought about by the combination of an element of plasma-fibrinogen with a fibrinoplastic element derived from the breaking down of the white corpuscles. This fibrinoplastic element consists of the substance which is known as Wooldridge's tissue- or cell-fibrinogen. A diminution of the available tissue-fibrinogen in the blood leads to a condition of diminished coagulability. Its addition to the blood in all cases is followed by an immediate increase of coagulability, and an increased formation of fibrin. In view of this fact a local application of tissue-fibrinogen would appear to be indicated when hæmorrhage in hæmophilia does not yield to the application of lime, or lime and fibrin-ferment. Tissue-fibrinogen may be obtained in the following manner: Procure the thymus gland (the *chest*-sweetbread) or testicle of a calf, lamb, or other animal from the butcher's. Mince it fine in a mincing-machine, and extract with, say, twenty times its volume of water for ten minutes to twenty-four hours. Strain through fine muslin or through flannel, and add to each pint of the strained infusion 1 fluid ounce of diluted or 1 fluid drachm of strong acetic acid (B.P.). A precipitate of tissue-fibrinogen forms almost immediately. Allow it to settle, and get rid of the supernatant fluid by decantation, or, better, collect the precipitate on a filter-paper. In either case dissolve the tissue-fibrinogen thus obtained by the addition of a few drops of alkali (dilute carbonate or bicarbonate of sodium). Apply the somewhat viscid solution on a tampon of cotton-wool to the bleeding point. Escharotics such as ferric chloride are seldom found to be of any service in bleeding in hæmophilia.

In cases of severe hæmorrhage, transfusion may be necessary.

General Treatment of the Morbid Condition.—It is impossible in our present ignorance of the pathology of hæmophilia to lay down a scientific method of treatment. It will, however, be evident that any treatment directed towards rendering the blood more coagulable would be indicated. Thus the administration of lime-salts might prove useful. Further, the means which are at our disposal for increasing the number of white corpuscles in the blood might be employed, with a view of increasing the amount of the fibrinoplastic element, for we have seen that tissue- or cell-fibrinogen is contained in the white corpuscles. While awaiting further information on this subject, the following therapeutic agents might be brought into requisition: (*a*) The administration of aromatic substances, such as camphor and turpentine. The administration of these substances increases the number of white corpuscles in the blood (Binz), and they are employed apparently with success in the treatment of internal hæmorrhages. (*b*) The administration of pilocarpine (Horbaczewski), which increases the number of circulating white corpuscles. (*c*) The administration of nuclein (Horbaczewski), or nuclein containing substances such as tissue-fibrinogen (Wright), for these substances increase the number of white corpuscles in the blood. They are available in the form of yeast, sweetbreads, lamb's fry, and kidneys. (?) It has, however, not yet been ascertained whether these cell-substances lose their efficacy on boiling.

Almroth E. Wright.

HÆMOPTYSIS (αἷμα, blood; and πτύω, I spit).—Synon.: Pneumonorrhagia; Bronchorrhagia; Fr. *Hémoptysie*; Ger. *Bluthusten*.

Definition.—Blood-spitting having its source in pulmonary or bronchial hæmorrhage.

The restriction of the term 'hæmoptysis,' as thus defined, has the sanction of long usage and convenience. Hæmorrhage from an aneurysm opening through the lung or air-passages would not strictly be included in such a definition.

Spitting of blood, when it arises from other and less important sources, comes under the denomination of *false* or *spurious* hæmoptysis. For *fictitious hæmoptysis*, see Feigned Diseases.

Ætiology and Pathology.—The causes of hæmoptysis in the widest sense of the term, and having regard to its pathology, may be thus enumerated:—

I. Hæmorrhage from the pulmonary artery or its radicles.

1. Rupture or wound of the lung from external violence.

2. Active hyperæmia of the lungs—inflammatory, vicarious, or induced by violent effort or excitement. The active hyperæmia may be primary as regards the lungs; or may supervene or be attendant upon disease already present in them. *See* Lungs, Hæmorrhage into; and Lungs, Inflammation of.

3. Mechanical hyperæmia of the lungs, secondary to heart-disease, or embolism of one of the pulmonary branches, or to pressure from tumours, such as enlarged bronchial glands. *See* Lungs, Hæmorrhage into; Bronchial Glands, Diseases of.

4. Necrotic division of vessels in the course of softening of tubercular or other consolidations in destructive lung-diseases—phthisis, tuberculosis, cancer.

5. Aneurysmal dilatation or simple erosion

of branches of the pulmonary artery, exposed in the course of excavation of the lung, or ulceration of the bronchial mucous membrane.

6. Primary atheroma of the pulmonary artery within the lung.

II. **Hæmorrhage from the bronchial capillaries.**—Capillary hæmorrhage from the bronchial mucous membrane.

III. **Hæmorrhage from the aorta, or one of its great branches.**—Aneurysm rupturing through the lung or into a bronchus.

Details respecting the pathology of these several forms of hæmoptysis will be found under the headings of the principal diseases giving rise to them. There are a few additional remarks, however, that should be introduced here.

The pathology of hæmoptysis occurring in early phthisis—of which it is one of the most frequent symptoms—is still somewhat obscure. Besides the active hyperæmia above referred to—that is, the inflammatory congestion that constitutes the first stage of some forms of phthisis, and tends to recur at different periods of the disease; besides also the necrotic division of vessels, or their aneurysmal dilatation, which more especially account for the hæmorrhage occurring in the later stages of the disease,—there are other conditions present in early phthisis which probably have much to do with the occurrence of hæmoptysis. The minute blood-vessels are importantly concerned in the very earliest stage of phthisical lung-disease in one or other of three ways:—

(*a*) Their walls become the seat of nuclear proliferation, and hence become softened; and (*b*) these vessels become more or less extensively blocked, not merely as the result of the inflammatory *stasis* which may affect their capillaries, but by the pressure of surrounding tubercular growth, or by tubercular thickening of their walls intruding upon their calibre. (*c*) It is very possible that in the ill-developed lungs of small-chested people, who inherit a tendency to consumption, the vessels are also morbidly frail, and are apt to give way in any temporary hyperæmia. Some persons are remarkably subject to irregular distribution of blood; they are liable to chills, cold extremities, and transient flushings; and a *pulmonary blush* is as conceivable as a temporary flush elsewhere, and would favour the occurrence of hæmorrhage.

It has been alleged that the hæmoptysis occurring in all stages of phthisis frequently has its source in hæmorrhage from the bronchial tubes, and that this bronchial hæmorrhage may give rise secondarily to phthisis, or may, when it occurs in the course of that disease, set up fresh centres of mischief in the lungs by inhalation of blood to distant portions. In the entire absence of reliable pathological grounds for this view, and in the abundance of anatomical evidence, clinical experience, and weight of authority in favour of the pulmonary origin of hæmoptysis, we are, in the opinion of the writer, justified in believing that decided hæmoptysis originating in hæmorrhage from the bronchial mucous membrane is exceedingly rare, excluding, perhaps, syphilitic ulceration of the bronchi. Blood inhaled to distant portions of lung may, however, as shown by Dr. Reginald Thompson, undergo changes resulting in fresh pulmonary destruction.

Description. — The quantity of blood brought up in hæmoptysis varies from a mere streak to two or three quarts. When blood is expectorated in large quantity, it is pure and unmixed; and either dark and venous, or bright arterial. The first and last portions are usually more or less aërated. If in small quantity, the blood is most generally bright and frothy, it may be only a speck or two upon the sputum, or it may be in several mouthfuls of pure aërated blood. It commonly happens that this mitigated and more characteristic hæmoptysis precedes the rarer attack of profuse hæmorrhage that may prove instantly fatal. Hæmoptysis is sometimes scanty, dark, and clotted, usually from a small portion of blood having been detained in the lung before being expectorated.

In decided hæmoptysis the shock to the system is always great. The patient is alarmed and anxious, especially on the first attack. The sense of weakness and prostration is, indeed, often prolonged after the attack—not necessarily a severe one as regards quantity of blood lost—has ceased. The face is often flushed; the extremities cold. The temperature is usually depressed; after a few hours it becomes normal, and it may continue so, or it may rise in the course of forty-eight hours or within five days. This elevation of temperature may depend (*a*) upon return of the previous fever after being temporarily checked by hæmorrhage and shock; (*b*) upon the cause which has also produced the hæmoptysis; or (*c*) upon the secondary consequences of the hæmorrhage. It has been clearly shown that the inhalation of blood into the bronchial tubes and pulmonary alveoli sometimes sets up broncho-pneumonia, and thus may give rise to fresh centres of phthisical disease; and cases do occur in which acute miliary tuberculosis of the lungs supervenes upon an hæmoptysis in a manner suggestive of direct infection. The later the rise of temperature up to the fifth day, the more reason we have for regarding it as due to secondary pneumonia.

In the hæmoptysis that occasionally arises in some forms of heart-disease (chiefly mitral stenosis), the amount of blood expelled is usually small, darker in colour, less aërated than in ordinary hæmoptysis, and partially clotted. This form of hæmoptysis is, moreover, associated with the signs of heart-disease of more or less old standing. *See* Lungs, Hæmorrhage into.

Anatomical Characters.—These depend very much upon the nature of the disease which has preceded the hæmoptysis. In cases of death from hæmoptysis there are the usual appearances of death from hæmorrhage—pallor of organs, empty and contracted ventricles, &c. The bronchial tubes of both lungs are found to contain clots. The healthy portions of lung are found inflated from obstructions in the bronchi, impeding the exit of air; they are generally pale, but beautifully speckled by pink spots, marking the lobules into the air-cells of which blood has been inhaled. If death take place several days after profuse hæmoptysis, any blood which remains in the bronchi is dark and disorganised, and patches of consolidation may sometimes be found, having for their centres the stained appearance attributable to inhaled blood. More or less bronchitis is also noticeable. It is rare to find fatal hæmoptysis without the presence of cavities, which are also, more or less, filled with blood-clot. In almost every instance of fatal hæmoptysis in phthisis, sufficient diligence will discover either an aneurysm of a pulmonary vessel within a cavity, or ulcerative erosion or laceration of an exposed vessel. The writer has found such a condition in fifteen cases at various ages, including one infant seven months old.

Significance of Hæmoptysis.—No modification in our views respecting the nature of phthisis can lessen the significance of hæmoptysis as being one of its most important positive signs. Thus regarded, it is a warning that may sometimes save, and very often prolong life, by drawing our early attention to a condition that might otherwise remain too long concealed; but, lightly considered and carelessly treated, it is but the precursor of destructive disease.

Diagnosis. — Genuine hæmoptysis can rarely be mistaken by a skilled observer present at the attack. The gurgling in the bronchi, the loose cough, and repeated expectoration of *bright frothy* blood are quite characteristic. The blood is distinctly expectorated with cough, not vomited; and its quality is distinctly fresh, not changed. In hæmatemesis, with which hæmoptysis is sometimes confounded, the blood is brought up by vomiting; is more or less mixed with the contents of the stomach; and, save when the hæmorrhage is very rapid and abundant, presents a dark grumous appearance, owing to the action of the gastric fluid upon it (*see* Hæmatemesis). It may, too, be observed that the blood does not come from the nose, unless a small quantity be projected through the nostrils with the spasmodic cough. If, as often happens, no medical attendant is at hand at the moment of the attack, the appearance of the blood is usually sufficient for diagnosis; and if the hæmoptysis have been at all copious, any further expectorations for the next few hours are sanguineous. The fact of this sanguineous coloration of the sputa having existed for some hours, or a day or two after an hæmoptysis, is positive evidence of the hæmoptysis having been genuine. In cases of *very copious* hæmorrhage from a large pulmonary branch, the blood brought up is dark and venous.

It is very important in investigating the cause of hæmoptysis to be as gentle as possible in physical examination. We can listen to the lungs in front and to the heart without moving the patient or requiring him to breathe deeply; we can make a note of the temperature; and at the time we should do no more.

The throat should always be examined in doubtful cases of hæmoptysis, as the blood will sometimes be found to have issued from an ulcerated tonsil, or even from enlarged vessels on the posterior wall of the pharynx. *Spurious hæmoptysis*, however, may be defined as *the escape of a blood-stained mucus from the throat or gums.* In cases of spurious hæmoptysis there is usually distinct evidence of a morbid condition of these parts. The mucous membrane of the fauces is relaxed; the gums are spongy, and often bleed when the teeth are brushed in the morning. Sometimes this condition of gums arises from insufficient attention to the teeth, carious stumps and much tartar round the teeth causing irritation and sponginess of the gums. The patients are usually anæmic and short-breathed, and often complain of morning cough, but there is no evidence of lung-disease. The blood-stained mucus is usually ejected in the morning, on waking; and often escapes from the mouth during the night, staining the pillow. On examination, it is found to be a pink, watery mucus, uniformly stained, and containing comparatively few blood-corpuscles.

Treatment.—Absolute rest is the first thing to be observed in the treatment of all attacks of hæmoptysis. The patient should lie down with the head and shoulders raised by pillows. He should not talk. The room should be kept quiet and cool; the bedclothes should be light, but sufficient; and warmth should be applied to the feet. A little ice in the mouth, or some iced water to sip, will ease the cough and tend to check hæmorrhage. The patient must, if possible, be reassured as to the absence of immediate danger, and the shock to the system allayed without the use of stimulants. Sometimes opium may be usefully given for this purpose, due regard being had to the habits and idiosyncrasies of the patient. In copious hæmorrhage, attended with shock, a small subcutaneous injection of morphine is sometimes of great value. Astringent medicines are not always needed in hæmoptysis, especially in attacks in which the hæmorrhage is presumably capillary; they may, however, be given in such cases in small doses. To be really useful in hæmoptysis, astringents must be given in full doses. Those most used are acetate of lead, four grains, every three or four hours; alum, twenty grains, with diluted sulphuric acid, thirty minims, every four hours; gallic acid, twenty to thirty grains every half-hour or hour, for two or three doses, followed by ten-grain doses every three hours; oil of turpentine, thirty minims every two hours in sweetened mucilage or in milk, for a couple of doses, then in half or third doses; liquid extract of ergot in half-drachm or drachm doses, every two or three hours; ten- or fifteen-minim doses of the pernitrate or persulphate of iron solution, or thirty or forty minims of the perchloride freely diluted. Of the above-mentioned astringent remedies, alum and sulphuric acid, gallic acid, and ergot are the best in the greater number of cases. Acetate of lead is less applicable to cases of lung-hæmorrhage than in bowel or kidney lesions. Ergot is to be preferred in those cases in which we infer that a considerable vessel has given way. It may also be given in the form of ergotin—one-half to two grains hypodermically; but thus given it sometimes causes much local inflammation. Oil of turpentine is certainly one of the most powerful of astringents in pulmonary hæmorrhage, and may be usefully held in reserve. When freely administered, the condition of the urine must be carefully noted. Cases of hæmoptysis only rarely occur in which it is well to give the iron astringents. As a rule, they tend to increase pulmonary congestion; but in some cases, in which hæmoptysis has a tendency to continue after the patient has been brought to a state of profound anæmia from the first outburst, they may be usefully given, their effect being carefully watched. Digitalis is a drug sometimes of great value in hæmoptysis; it is best adapted to those cases in which there is much excitement of the circulation. In cases, for instance, in which the hæmoptysis has been determined by intemperance, or in full-blooded people by effort, tincture of digitalis in twenty- or thirty-minim doses may be given. In such cases, in which the portal system is usually congested, sulphate of magnesium and diluted sulphuric acid may be combined with the digitalis, and given every four or six hours for a couple of days or so. In the treatment of hæmoptysis it is usually necessary to counteract the effect of the astringent upon the bowels by purgatives or laxatives. An enema may be necessary to enable the bowels to act easily and without straining. The use of the bed-pan must of course be enjoined.

Counter-irritation is of great value in the treatment of many cases of hæmoptysis, chiefly in those cases in which the hæmorrhage is not great, and occurs in the course of phthisis, being due either to local pulmonary congestion or to active hyperæmia of the walls of a cavity. Blisters are, as a rule, best avoided in copious hæmoptysis during the stage of shock. Continuous cold to the chest is decidedly to be deprecated. The intermittent application of cold may sometimes be employed, but is a measure of doubtful expediency.

The temperature and pulse of the patient should be carefully watched during an attack of hæmoptysis, and for days afterwards.

The diet must at first be restricted to cold nutritious fluids. The tendency is to keep patients suffering from hæmoptysis on cold slops and cold solids for an unnecessary time. In most cases, after forty-eight hours, warm, not hot, food may be allowed. Stimulants, except in special cases, must be interdicted.

The treatment of *false* or *spurious hæmoptysis* depends upon its cause. In most cases, the cause being anæmia, with a relaxed and morbid condition of the mucous membranes, an acid preparation of iron containing some chlorate of potassium and glycerine will speedily cure the malady. Tincture of the acetate or perchloride of iron, added to a small 'lemon-squash,' is also an excellent remedy. When the gums are spongy, the addition to a chalk or charcoal tooth-powder of finely powdered kino or catechu, or the addition of some glycerine of tannin to the tooth-water, will prove efficacious. Astringent gargles will suggest themselves in fitting cases; and fruit and vegetables must be added to the diet.

R. Douglas Powell.

HÆMORRHAGE (*αἷμα*, blood; and *ῥήγνυμι*, I burst forth).—Synon.: Fr. *Hémorrhagie*; Ger. *Blutfluss.*

Definition.—The escape of blood from any part of the circulation, and its discharge from the body.

When blood escapes from any of its natural reservoirs, it is either extravasated into the neighbouring organs or cavities, or flows from one of the surfaces or orifices of the body. In the latter case only is the term 'hæmorrhage' strictly applicable (*see* Extravasation). This distinction, however, is not always carefully observed; and such expressions as 'cerebral hæmorrhage,' 'hæmorrhage into the pericardium,' and 'hæmorrhagic eruptions' are employed in connexion with what are more correctly called *extravasations* of blood.

Ætiology.—Hæmorrhage is almost always due to a solution of continuity of some part of the circulatory system, whether by injury or by disease. Hæmorrhage from the external surface of the body is, with few exceptions, the result of wounds or other form of injury; but ulceration—either simple or malignant—frequently lays open a vein or an artery; and aneurysm of the great vessels, and even of the heart, may also give rise to external bleeding. Hæmorrhage from internal organs, on the contrary, is most frequently the result of disease, as, for instance, ulceration or aneurysm, or of circulatory disturbance, such as congestion. Great excitement and severe exertion are two of the chief determining causes of hæmorrhage, by producing great or sudden rise of the general blood-pressure, whether by cardiac disturbance or by obstruction of the terminal vessels; they may lead even to the rupture of healthy vessels. Local disturbances of the blood-pressure give rise in the same way to congestion or hyperæmia, and finally to hæmorrhage. The principal causes of hæmorrhages of this class are diseases of the heart, of the great vessels, of the respiratory organs, and of the liver, and sudden variations in the atmospheric pressure or in the temperature; and such hæmorrhages are also in some instances undoubtedly of a *vicarious* nature. Certain conditions of the blood are believed to predispose to hæmorrhage, as, for example, in scurvy, purpura, the malignant fevers, chronic Bright's disease, and alcoholism. There is, probably, however, a lesion of the vessel-walls in some of these diseases. A peculiar condition of body is known as the *hæmorrhagic diathesis* or hæmophilia; the subjects of which exhibit, amongst other forms of debility, a remarkable tendency to profuse hæmorrhage from trivial causes. *See* HÆMOPHILIA.

SEATS AND VARIETIES.—Bleeding from the surface of the body, whatever its origin, is simply called *hæmorrhage*, and its exact source and situation are otherwise defined. On the contrary, when blood escapes by any of the natural openings of the body, and is derived from an internal organ, the hæmorrhage is described by a special name. Hæmorrhage from the nose is called *epistaxis*; from the ear *otorrhagia*; from the stomach *hæmatemesis*; from the respiratory tract *hæmoptysis*; and from the urinary tract *hæmaturia*. Blood passed *per anum*, after undergoing certain changes to be referred to immediately, is called *melæna*. *Menorrhagia* and *metrorrhagia* are the names given to profuse bleeding from the genital organs in the female—at the menstrual period and at other times, respectively.

DESCRIPTION.—The local phenomena which characterise hæmorrhage from the external parts of the body, vary with the source of the blood. If it proceed from an artery of considerable size, it escapes in the form of a jet, which is strengthened at each beat of the pulse as an active spurt. Blood discharged from an opened vein either flows in an abundant continuous stream, or wells up from the depth of the tissues in which the vessel lies. Capillary hæmorrhage is generally much less profuse, and is most frequently seen in the form of oozing. Blood proceeding from internal organs is variously discharged by the several outlets. Sometimes it is immediately expelled, especially if in quantity; or it may escape even when in small quantity, owing to gravitation, as in hæmorrhage from the nose. Most frequently the blood is retained for a time, and then, acting as a foreign body, is ejected; for example, in bleeding from the stomach, bowels, or bladder.

Characters.—Blood flowing from the surface of the body usually presents its familiar characters. The colour of the blood will be scarlet when it is derived from an artery; purple, with a tendency to become scarlet on the surface, when it flows from a vein; and of a tint intermediate between these two colours when the hæmorrhage is capillary. In all cases, the blood coagulates more or less abundantly around the seat of hæmorrhage.

In hæmorrhage from internal organs, on the contrary, the blood is frequently coagulated; more or less mixed with the fluids of the part; or otherwise altered during its transit. The following are the principal changes that blood undergoes in its passage towards the several outlets of the body:—

Blood flowing from the *external ear*, or from the *anterior nares*, is frequently thin and watery, if the hæmorrhage have lasted for any length of time. Blood discharged from the *posterior nares* is often coagulated, black, and mixed with thick mucus. In hæmorrhage from the *mouth*, the blood may be derived from that cavity, from the fauces, from the respiratory passages, or from the upper portion of the digestive tract—especially the stomach. When the blood flows from some part of the *mouth*, such as the gums, tongue, palate, or cheeks, it is more or less intimately mixed with frothy saliva and mucus. In hæmorrhage from the *respiratory passages*, or from the *stomach* through the mouth, the ejected blood varies extremely in different instances (*see* HÆMOPTYSIS; and HÆMATEMESIS). Hæmorrhage from the genito-urinary tract is also specially described. Hæmorrhage from the bowels is not peculiar, if the source of the blood be near the anus, or if the bleeding be very profuse; taking the form sometimes of a gush of fresh, warm blood, at other times of a mere red streak upon the fæces. If the blood be derived from a higher part of the intestines, the appearance of it, when discharged, will be different. Generally it is so far altered by the action of the various intestinal contents, as to be converted into a black tarry-looking mass (*see* MELÆNA). Less frequently, the bleeding may be so profuse as to fill a considerable portion of the bowel, and clots of blood may then be passed, as in some cases of hæmorrhage in typhoid fever. The peculiar characters of *menstrual* blood are described elsewhere. Hæmorrhage from the *uterus* in large quantity consists of unaltered blood, whether coagulated or not.

Course and Terminations. — Hæmorrhages caused by wounds are generally most profuse at first; and, unless they prove fatal speedily, or are artificially arrested, gradually cease. On the contrary, hæmorrhages due to disease are frequently insignificant at first, and increase in amount; or they recur again and again in variable quantity.

Many natural causes contribute to the arrest of hæmorrhage, the most important being weakening of the force of the heart by the loss of blood; the contraction of the coats of the vessels at the seat of lesion; the coagulation of the blood—first around, and then within the open vessel; the pressure of the extravasated blood in the surrounding tissues; and the increased coagulability of the blood after the flow has continued for some time. The relief of the local disturbance of pressure by the occurrence of the hæmorrhage is alone sufficient in many instances to arrest the flow.

Effects.—The effects of hæmorrhage are chiefly exerted upon the system generally; and they are therefore remarkably uniform, whatever may be its locality. The circumstances that more especially affect the intensity of the effects or symptoms are two, namely, the amount of blood lost, and the rapidity of the flow. When hæmorrhage is at once free and persistent, syncope rapidly ensues, probably accompanied by convulsions, and ending speedily in death unless the bleeding either spontaneously cease or be artificially arrested (*see* Syncope). The sudden loss of one-half of the total amount of blood in the body is believed to be sufficient to cause death. On the other hand, enormous quantities of blood may be lost without a fatal result if the hæmorrhage be slow, or frequently repeated with considerable intermissions. The condition of the subject of the hæmorrhage then becomes one of anæmia (*see* Anæmia). More moderate bleedings frequently repeated produce faintness, and may cause a certain degree of pallor, which shortly disappears. Moderate hæmorrhages from certain situations, for example from the nose, rectum, or even the lungs, may sometimes remove congestion, and be attended with a feeling of relief and with real benefit.

Local effects do occur in some forms of hæmorrhage. Hæmoptysis is frequently accompanied by inhalation of blood, and may lead to inflammation or more complex disease of the lungs. Hæmorrhage into the uriniferous tubules causes plugging of these, and discharge of blood-casts. Blood retained in the generative or in the respiratory passages occasionally becomes decomposed. The special symptoms of the several forms of hæmorrhage are described under the head of each.

Treatment.—The treatment of hæmorrhage from external parts is a subject of purely surgical interest; but it may be said that, in cases of emergency, moderate pressure, with the finger or other means, on the seat of the bleeding, is generally practicable and successful. Hæmorrhage from internal parts requires special treatment according to the particular organ from which it is proceeding. The reader is, therefore, referred to the several articles on Epistaxis; Hæmatemesis; Hæmaturia; Hæmoptysis; Melæna; Menses or Menstruation, Disorders of; Hæmostatics; and Styptics.

J. Mitchell Bruce.

HÆMORRHAGIC (αἷμα, blood; and ῥήγνυμι, I burst forth).—Associated with hæmorrhage. The word is applied to certain inflammatory products or to effusions when they contain blood, as in *hæmorrhagic peritonitis*; and to varieties of certain diseases in which extravasations or hæmorrhages from free surfaces occur, for example *hæmorrhagic small-pox*, *hæmorrhagic measles*, and *hæmorrhagic purpura*.

HÆMORRHAGIC DIATHESIS. *See* Hæmophilia.

HÆMORRHOIDS (αἷμα, blood; and ῥέω, I flow).—Synon.: Piles; Fr. *Hémorrhoïdes*; Ger. *Hæmorrhoiden.*

Description.—The hæmorrhoidal vessels, and especially the veins distributed to the lower part of the rectum, are very liable to become dilated and varicose, giving rise to a disease termed *hæmorrhoids* or *piles.* When the plexus beneath the mucous membrane within the external sphincter is thus affected, the hæmorrhoids are said to be *internal.* When the veins beneath the integuments outside the muscle are enlarged, the hæmorrhoids are called *external.* Internal and external hæmorrhoids very frequently co-exist.

External Hæmorrhoids.—We may distinguish two kinds of external piles—(1) the *venous*; and (2) the *cutaneous.*

(1) The *venous tumour* consists of a softish elevation of the skin near the margin of the anus, of a rounded form, and a livid or slightly blue tinge. On cutting into it, we find it is formed by a dilated vein or veins, which after inflammation will be occupied by a dark-coloured coagulum.

(2) The *cutaneous excrescence* consists of a flattened prolongation of skin, due to hypertrophy of the cutaneous layers, and is commonly pedunculated. It is generally the result of the first form—a projecting skin tag left after absorption of the coagulum having undergone some hypertrophy. Often there is only a single broad flat excrescence at the side of the anus, but sometimes there are two—one on each side; and occasionally there are

several encircling the anus. They are apt to become inflamed and œdematous. Similar excrescences occur as the result of irritating discharges from the bowel, and are common in stricture and chronic ulceration of the rectum.

Internal Hæmorrhoids.—Internal piles may be divided into three classes—(1) the *venous*; (2) the *columnar*; (3) the *nævoid.*

(1) The *venous pile* resembles the external venous pile, except that it is covered by mucous membrane and is within the sphincter.

(2) The *columnar pile* consists essentially of hypertrophy of the folds of mucous membrane which surround the anal opening —the pillars of Glisson. They have a red, almost vermilion, colour, an elongated form, and contain within them one of the descending parallel branches of the superior hæmorrhoidal artery' (Hamilton). This pile is very vascular, bleeds copiously, and is made up of hypertrophied submucous tissue with many dilated arteries and veins.

(3) The *nævoid pile* is bright red, spongy and villous, and has been well compared in aspect to a strawberry. In structure it resembles a capillary nævus. It may bleed almost continuously.

Internal piles seldom attract attention until they have become so developed as to protrude at the anus in defæcation. They then exhibit a remarkable diversity of appearance, according to their number, size, and condition. The protrusion may consist of only one large pile, found usually towards the perinæum, especially in women. More commonly there are three distinct prominent growths, differing in size, one at each side of the anus, and a third in front—the latter, the perineal, being the largest. In old cases they may be more numerous—as many as four or five. The distinction between them is commonly well-marked, but not always, for the piles sometimes merge into each other, so that the protrusion forms nearly a circular prominence. The aspect of extruded piles depends much upon their condition, whether congested, inflamed, or constricted by the sphincter. In an inactive state, and in a relaxed condition of the sphincter, they form softish tumours of a granular appearance, presenting just at the orifice of the anus; but when protruded and congested, they constitute large tense tumid swellings, of a deep red colour and smooth surface, which readily bleed. When hæmorrhoids are of large size, the integuments at the margin of the anus become everted, and form a broad band girting the base of the tumours. The skin thus everted is liable to be mistaken for external piles, and to be excised in operations—an error very likely to be followed by serious contraction of the anus.

Ætiology.—Hæmorrhoids are a disease of middle and advanced age. They rarely occur before puberty; and but few persons in after-life altogether escape them. All circumstances which determine blood to the rectum, or which impede its return from the pelvis, tend to produce this disease. There is in many persons a natural predisposition to the complaint, which may be hereditary. But a predisposition is most frequently acquired by sedentary habits, indulgences at table, and neglect of the bowels. Hæmorrhoids, though a common disease in both sexes, occur more frequently in males than in females. Few women bear children without becoming in some degree affected by them; but the urinary and genital disorders of the other sex, combined with freer habits of living, leading to congestion of the liver, are still more fertile sources of piles. It must be remembered that piles may be a symptom only in certain cardiac, hepatic, or uterine diseases.

Symptoms.—The symptoms produced both by external and internal piles vary greatly in different subjects, and in different stages of the complaint.

External piles cause a feeling of heat and tingling at the anus. A costive motion is followed by a burning sensation, and the excrescence becomes swollen and tender on pressure, so as to render sitting uneasy. This congested state of the pile may pass off; or it may lead to inflammation accompanied with considerable enlargement of the hæmorrhoid, forming an oval tumour, red, tense, and extremely tender. In such case phlebitis has ensued, and the pile cavity is occupied by a coagulum. The inflammation may subside or go on to suppuration. When the matter is discharged, the clot of blood escapes with it, the abscess closes, and the dilated vein is usually obliterated, the pile being reduced to a small flap of integument. External piles rarely give rise to bleeding.

Internal piles, when slight, may exist for years, causing little inconvenience besides slight bleeding after a costive motion; with occasionally a feeling of fulness, heat, and itching just within the anus. If only small, they protrude slightly with the mucous membrane in defæcation, returning afterwards within the sphincter. When of large size, the piles always protrude at stool, and require to be replaced, the patient usually pushing them up with his fingers. In a lax state of the sphincters, and in a loose hypertrophied condition of the mucous membrane from which they spring, hæmorrhoids come down, even when the patient stands or walks about, so as to prove exceedingly troublesome, and to interfere with his taking walking exercise. In consequence of the irritation from pressure and friction to which the protruding piles are liable, their mucous surface becomes tumid and abraded, and furnishes a free mucous discharge tinged with blood, which soils the linen. They are often so sore that the patient is obliged to keep the recumbent posture, the pressure in sitting causing more or less uneasiness.

Persons subject to piles frequently suffer no inconvenience from them until irritated by an unusually costive motion, or by a smart purgative; or when, under the excitement of alcohol, the growths become congested and inflamed, and cause spasm of the sphincter muscle. Then they have what is termed an 'attack of piles'—that is to say, they experience a sensation of heat, weight, and fulness just within the rectum, followed by considerable pain at stool, and sometimes irritation about the bladder. These symptoms, which are often attended with febrile disturbance, arise from inflammation and swelling of the piles, which afterwards subside, but seldom without leaving some enlargement of the growths. Anæmia may follow upon continued bleeding; and reflex pains in the back, groin, and genitals are often complained of.

Strangulation.—When internal piles of some size protrude at the anus and are not returned, they are liable to be constricted and strangulated by the external sphincter. The contracted muscle impedes the return of blood, and occasions inflammatory swelling of the piles, which may become strangulated and gangrenous. In this way hæmorrhoids of large size have been known to slough off, the patient being relieved of the annoying complaint by a sort of natural process. An occurrence of this kind is attended with a good deal of pain and suffering, but is free from danger. In general, the extremities only of one or two of the larger growths perish, and the patients, though experiencing relief, are by no means cured of the disease.

Hæmorrhage.—One of the most common symptoms of internal hæmorrhoids—indeed that from which the name of the complaint is derived—is hæmorrhage, which occurs when the bowels are evacuated. The bleeding varies greatly in amount. Sometimes the motions are merely tinged with a few drops of blood; in other instances the quantity lost is considerable, several ounces being voided at stool. The bleeding may be irregular, occurring only after costive motions, or in certain states of health; or it may take place daily, going on even within the bowel, and producing the usual symptoms of derangement from continued losses of blood. The character of the bleeding also varies with the structural character of the pile, being, however, usually venous. There are persons who are liable to discharges of blood from the hæmorrhoidal veins, either at regular periods, or when, from good living or want of exercise, some plethora is induced. In these cases from three to six ounces of blood, or even more, pass away at stool, following the evacuation; and the blood which is voided is of a dark colour and evidently venous. Such discharges must not be rashly interfered with. They relieve congestion of the liver and kidneys, help to ward off attacks of gout, and prevent fits of apoplexy; so that in certain of these plethoric persons they are rightly regarded as safety-valves. The bleeding from internal piles is undoubtedly in some cases arterial. Sometimes the blood may be observed to escape from the pile in jets. This is not evidence that it is arterial, but may be due to a regurgitant stream of blood forced through a rent in a vein by the pressure of the abdominal muscles. That bleeding from piles is always good for the health is quite a mistaken notion; and it is important that the practitioner should distinguish the bleeding taking place as a consequence of local disease, from that which arises from plethora, congestion of internal organs, or such a disease as cirrhosis of the liver.

TREATMENT.—When piles are small and cause but little inconvenience, the treatment is very simple. Persons with this complaint should take stimulants in great moderation, if at all; and in most instances they would do well to abstain entirely from alcohol. Many individuals never suffer from piles except after taking a glass of spirit-and-water, or a few glasses of wine. Such persons should become water-drinkers. Active exercise in the open air should be taken daily; and the patient should avoid sitting too long at the desk, because it is by prolonged sedentary occupation and the neglect of the rules of health that hæmorrhoidal complaints are encouraged. Chairs with cane seats are to be recommended. The bowels must be carefully regulated, so as to avoid hard and costive motions, as well as too frequent action. Irritating the rectum by active and repeated purging is more hurtful even than constipation. In regulating the bowels, a simple enema of half a pint of cold water, injected after breakfast, answers most admirably, and is more efficacious than purgatives. If aperients be needed, preference may be given to confection of senna, cascara, or the compound liquorice powder. Carlsbad salts, or the foreign mineral waters—the Pullna, the Friedrichshall, or the Hunyadi Jànos—taken in the morning fasting, answer well with many persons, and ensure a comfortable relief. The diet must be simple and moderate, and the habits of the patient regular. The relief afforded by this palliative treatment is often remarkable.

Ordinary bleeding may be met by injections of cold water, or by some astringent injection or ointment; among these may be named a solution of sulphate of iron (10 grs. to ℥j), or preparations of tannic acid or rhatany. When the bleeding is copious, injections are not so successful, and operative treatment often becomes necessary. As a local application, the ointment of galls and opium is of value, or a combination of morphine and tannic acid.

External piles when large and troublesome, and internal piles when they protrude at stool, and are not easily reduced, or are subject to inflammation, ulceration, and frequent bleeding, can be removed only by operation. It is seldom desirable to operate upon piles developed during pregnancy, or upon hæmorrhoids symptomatic of grave constitutional disease.

T. B. Curling. Frederick Treves.

HÆMOSTATICS (*αἷμα*, blood; and *στατός*, stopped).

Definition.—Internal remedies and local applications which arrest hæmorrhage.

Enumeration.—The chief hæmostatics are: the Ligature; Pressure; Rest; Cold; the Actual Cautery; Astringents; and the whole class of Styptic drugs.

Actions and Uses.—When taken in their widest sense, it is evident that hæmostatics must include all the various means which have been devised to stop bleeding. Externally we must vary our plan of treatment according to circumstances. No surgical principles are better founded than those which enjoin us to tie a wounded artery, and to apply pressure to a vein; and for the absolute arrest of hæmorrhage from any readily accessible part a most powerful aid has been provided in Esmarch's elastic bandage. When the bleeding depends on general capillary oozing, the application of ice may often prove effectual; and where this fails, recourse must be had to some of the numerous articles of the Pharmacopœia, already referred to, which possess styptic properties (*see* Styptics). An example of the successful application of a hæmostatic is the arrest of uterine hæmorrhage by means of injections of perchloride of iron. In the case of undue hæmorrhage from a leech-bite, if milder remedies, such as pressure, do not succeed, we may apply the solid nitrate of silver, or include the bleeding point in a loop of twisted suture.

Absolute rest is essential for the successful treatment of hæmorrhage; and the regulation of the diet and of the bowels is equally to be attended to. For the details of treatment in each particular form of hæmorrhage, the reader is referred to Hæmatemesis; Hæmophilia; Hæmoptysis; Melæna; &c.

Robert Farquharson.

HÆMOTHORAX.—*See* Hæmatothorax.

HAIR.—The intimate anatomical relations which exist between the hair and the cuticle, on the one hand, and the skin-follicles on the other, naturally influence or determine the diseases to which the hair is liable. These diseases may be divided into three chief groups: those of nutrition and growth, including atrophic, hypertrophic, and pigmentary changes; diseases associated with inflammation of the follicles, such as sycosis and other forms of folliculitis; and parasitic affections. The two latter groups will be found described under their respective heads, so that in this place we have to deal chiefly with the first group.

Diseases involving the Nutrition and Growth of the Hair.—Most of the alterations in the growth and colour of the hair are atrophic in their nature. The more common forms of atrophy produce various kinds of baldness; and in addition we have greyness or loss of the natural colour of the hair, and certain structural alterations, such as those met with in trichorexis nodosa; these latter alterations, though not simple atrophies, yet belong to the atrophic group.

Alopecia or Baldness.—Baldness is of two kinds—*congenital* and *acquired. Congenital* alopecia is very rare; it is a malformation rather than a disease, and is generally associated with a defective development of the teeth. This condition is permanent.

Acquired baldness arises from many different causes. It may result (1) from *various forms of disease*; (2) from simple *defective nutrition and growth*; or (3) from *atrophic senile changes.*

(1) *Baldness from various forms of disease.*—Different diseases produce baldness in different ways, and they may be conveniently divided into four groups: acute febrile diseases; follicular inflammations; nervous affections of the skin; parasitic diseases.

The baldness which follows *fevers* is always temporary, though often severe. There is apparently an almost sudden death of the hair at the time of the fever, and this is followed by its falling off some two or three months afterwards. Parturition and some other illnesses besides fevers produce a similar result, though generally more slowly and persistently. The falling off of the hair which accompanies secondary syphilis is apparently produced in a similar way, and often occurs without any visible eruption on the scalp.

Folliculitis, or inflammation of the hair-follicles, is one of the commonest causes of baldness. We meet with it in seborrhœa capitis, in sycosis, and in various pustular eruptions involving the hair-follicles. When produced in this way, alopecia may be temporary or permanent, according to the nature or the severity of the disease. All diseases of the skin which leave scars or obliterate the follicles lead to permanent alopecia of the parts affected. Erythematous lupus, scleroderma, and some forms of syphilis, are examples. It is especially these forms of alopecia resulting from folliculitis which are so much aggravated by the stimulating applications almost universally recommended by hairdressers, without regard to the cause of the malady.

The changes in the *nervous system* which produce baldness may be general, as in some cases of shock; or local, as in alopecia areata. Falling of the hair, which sometimes follows a blow or other injury, belongs to this class. *See* Alopecia areata.

The *parasitic diseases* which lead to partial baldness are tinea tonsurans and favus, which are fully described under their proper headings.

(2) *Baldness from defective nutrition*; and (3) *Senile baldness.*—Premature baldness from defective nutrition differs little from senile alopecia, and is often hereditary. The changes, however, in these cases are said to differ from those due to old age, inasmuch as there is no thinning or atrophy of skin such as we meet with in senile baldness. This view is, however, certainly erroneous with regard to the great majority of cases, which are quite indistinguishable from senile baldness, not only in the part of the head affected, but also in the atrophic changes of the scalp itself. The two cases, in short, differ only in degree and not in kind.

The treatment of this kind of alopecia, as might be expected, is not very satisfactory. Some good, however, may be done in the early stages by stimulating remedies. One of the best is a lotion consisting of vinegar of cantharides, f. ʒvi.; glycerine, f. ʒj.; spirit of rosemary, f. ℥ij.; rectified spirit, f. ℥v. This should be dabbed on the scalp daily with a small sponge. Frequent and excessive sweating is certainly an exciting cause of premature baldness in those predisposed to the malady, and hence its frequent occurrence in Europeans who live in tropical climates. *See* Baldness.

Pigmentary changes.—Canities, or greyness, results from the deficient development of the natural pigment of the hair. It may be congenital or acquired. The extreme form of congenital canities is met with in albinos, in whom there is an absence of pigment in the skin and choroid as well as in the hair. In an irregular form it sometimes exists as a congenital white lock on the scalp or face, the surrounding hair being of a normal colour.

As an acquired alteration in the hair, canities is well known as a simple senile change. Premature greyness, not differing essentially from the senile change, is often met with in those suffering from any chronic disease, such as phthisis; it is also more or less hereditary. In all these cases the greyness is symmetrical. In an unsymmetrical form it is met with in several diseases of the skin, especially in area, leucoderma, and chronic neuralgia of the scalp. The distribution of the grey hair and the history of the case will serve as a means of differential diagnosis.

In many cases of canities any treatment is obviously useless. In those cases which admit of rational treatment, cantharides is by far the best local stimulant, as it has a tendency to excite the natural development of colouring matter, as may be often seen in the skin where a blister has been applied. Arsenic is usually the best form of tonic for the same reason.

Excessive growth of hair.—Writers have generally stated that hairs may increase in numbers and size. With regard to an increase in their numbers, the statement cannot be accepted. Downy and almost invisible hairs may grow into strong and visible ones, but there is never any increase in their number; it is really a great increase in their size which leads to the erroneous belief that they have multiplied. Sometimes the old hair is held in the follicle after the new hair has grown up, but this is not a true increase of numbers. An excessive growth of hair is not uncommon, and is chiefly inconvenient on the face in women. The ordinary depilatories which are used to get rid of this excessive growth are worse than useless. *See* Depilatories.

Structural change in the hair.—Trichoclasis, or *trichorexis nodosa*, is the most important and best-known change in the structure of the hair. The affection was first described by the late Erasmus Wilson and Beigel. To the naked eye the hairs appear to be marked with two, three, or more small bulging spots, somewhat resembling nits. The hairs very easily break at these points, which, examined under the microscope, seem to consist of spindle-shaped swellings of the shaft of the hair. In a more advanced stage this swelling partially bursts near its most distended part, and finally the hair breaks with a ragged fracture, so that the divided hair has the appearance of two brushes, the bristles of which are interlocked. When the separation is complete, a stumpy hair is left with a frayed or brush-like free extremity. Trichorexis is chiefly met with in the hairs of the face, especially those of the chin.

Lepothrix.—Although this curious affection is a concretion rather than a structural change of the hair, yet it has that appearance to the naked eye, and may be conveniently referred to under this head. The hairs affected with this disease are met with in the axillæ and on the scrotum. Indeed, warmth and moisture appear to be essential to its development. The concretions, seen under the microscope, have usually a rounded and nodulated form apparently surrounding the shaft of the hair, but not symmetrically. Sometimes the concretion extends continuously for some distance along the shaft of the hair, giving it a feather-like appearance. The hairs themselves are abnormally brittle. The exact nature of these curious concretions has not yet been determined, but they are associated with a micrococcus. *See* Lepothrix.

Robert Liveing.

HALL, in Austria.—Common salt waters, with iodine. *See* Mineral Waters.

HALLUCINATION (*hallucinor*, I blunder).—A false perception of an organ of sense, for which there is no external cause or origin (*see* Illusion); as when a man in total darkness thinks he sees an object. Hallucinations of all the senses occur, the most frequent being those of sight and hearing. They may be found in persons not insane, but indicate a disordered state of brain.

HAMMAM-MELOUAN, in Algiers. Thermal muriated saline waters. *See* Mineral Waters.

HAMMAM-MESKOUTINE, in Algiers (the *Aquæ Tibilitinæ* of the Romans).—Highly thermal saline springs, weakly mineralised. *See* Mineral Waters.

HAMMAM-R'HIRA, in Algiers.—Highly thermal waters. *See* Mineral Waters.

HANGING, Death by.—Hanging is the effect of suspension of the body by the neck by means of a ligature or noose, the constricting force being the weight of the body, wholly or in part, or the weight multiplied by the distance through which the body falls. The mode of death varies according to these circumstances. With a long drop, the method now usually employed in judicial hanging, and particularly if the knot is under the chin, death is not infrequently due to fracture, or displacement, of the cervical vertebræ, and injury to the medulla oblongata. Death may also occur, without such anatomical lesion of the cervical vertebræ, from shock or syncope, or, as it is termed by Casper, neuro-paralysis.

When death does not occur in either of these ways, it is the result of asphyxia from occlusion of the air-passages, or rather of asphyxia in combination with coma, caused by compression of the cerebral blood-vessels. Though compression of the carotids and jugulars may be maintained for a considerable time without a fatal result, if the trachea is open below the point of constriction—whereas death speedily ensues if the air-passages are also occluded—yet death may result from the disturbance of the cerebral circulation alone; and the two causes operate conjointly in every case, in varying proportions.

Phenomena.—When death is not instantaneous, as in cases of injury to the medulla, or from neuro-paralysis, convulsive movements of the type seen in asphyxia may continue for some minutes after suspension, and the heart may continue to beat for a considerable period after all other vital movements have ceased.

Subjects who have been partially hanged have described various sensations, more or less pleasurable, similar to those of cerebral congestion and narcotic stupor.

Post-mortem Appearances.—The appearances found after death by hanging are not uniform or constant; and there is no single sign invariably present diagnostic of this mode of death. Indicative of suspension, but not necessarily of death so caused, is the mark of the cord on the neck. Usually it is above the hyoid, passing obliquely upwards behind the ears, and losing itself in the occiput. But the position may vary according to the tightness of the noose before suspension, or the position of the head and direction of the pressure. It is generally single, but if the cord should have been twisted twice round the neck, two marks may be found, one circular and the other oblique. The characters of the mark differ somewhat according to the texture and thickness of the ligature. Usually it is a shallow groove or furrow, of a whitish or brownish hue and parchmenty consistence, occasionally abraded, rarely ecchymosed; but it may have livid edges or a chocolate tint. The appearances may vary in different parts of the same mark. The subcutaneous cellular tissue is compressed and silvery. Occasionally minute extravasations are seen in the deeper layers of the skin. The middle and internal coats of the carotids are sometimes lacerated; and where the momentum has been great, lacerations of the cervical muscles, hæmorrhage in their vicinity, fracture of the larynx, rupture of the thyro-hyoid ligaments and fracture of the hyoid bone, and fracture or dislocation of the cervical vertebræ, with injury to the medulla and effusion into the spinal canal, have been found. All the appearances usually found in the neck in cases of hanging may be produced by suspension of the dead body, especially if the legs are pulled forcibly downward.

The face is sometimes, but not commonly, distorted and expressive of suffering. Usually it is placid and pale, though if the body have hung for some time, it becomes very livid. The eyes are sometimes very prominent, and the pupils are usually dilated. Frothy mucus may be found at the mouth and nostrils. The tongue is pressed against the teeth and indented, or it may be clenched between the jaws. The base of the tongue is injected. The hands are often tightly clenched, the nails even being driven into the palms. Erection, or semi-erection, of the penis in men, with expulsion of semen or prostatic fluid, and vascular turgescence of the genitals in females, with sanguinolent effusion, are occasionally observed. Expulsion of the contents of the bladder and rectum is likewise common. The condition of the brain varies. Congestion of the meninges is sometimes pronounced, at other times not very marked. The mucous membrane of the larynx and trachea is congested, and mucous froth is present. The lungs are at times pale and distended; at other times collapsed. The condition of the heart and venous system characteristic of asphyxia is common. Marked redness of the mucous membrane of the stomach, simulating irritant poisoning, has been occasionally noted. The determination of the fact of death by hanging depends on a consideration of these various phenomena, and the absence of other causes of death.

Accident, Suicide, or Homicide?—Hanging is rarely homicidal. It signifies great disproportion of strength between the assailant and the victim; and therefore, in the absence of this condition, there will be injuries indicative of a struggle. Apart from collateral circumstances, homicide can only be argued from the presence of such injuries as could not have been self-inflicted or caused accidentally during the act of suspension. Occasionally hanging is accidental, as in foolish experiments and insane imitation. It is not necessary that the body should be entirely off the ground to cause death by hanging. Many instances are recorded of suicide by hanging in most extraordinary positions calculated to throw the greater part of the body-weight on the noose.

Treatment.—This is rarely called for, except in accidents or attempted suicide. The body must be cut down, and artificial respiration employed. Venesection may be had recourse to for relieving cerebral congestion. *See* Artificial Respiration; and Resuscitation. D. Ferrier.

HARKANY, in Hungary.—Thermal sulphur waters. *See* Mineral Waters.

HARROGATE, in Yorkshire.—Saline, chalybeate, and sulphur waters. *See* Mineral Waters.

HASTINGS, on the South-East Coast of Sussex.—A mild climate. Mean winter temperature, 40° F. Exposed to the east, but sheltered from the north. *See* Climate, Treatment of Disease by.

HAUT MAL (Fr.)—A synonym for epilepsia gravior. *See* Epilepsy.

HAY FEVER. — Synon.: *Catarrhus æstivus*; Bostock's Catarrh; Hay Asthma; Fr. *Asthme d'été*; Ger. *Frühsommercatarrh.*

Definition.—A catarrhal affection of the mucous membrane of the eyes, nose, mouth, pharynx, larynx, and bronchi, accompanied by dyspnœa; induced in persons predisposed to it by the action of the pollen of various plants, chiefly of the Graminaceæ; prevalent during the hay season, but subsiding at its close; and varying in severity according to certain atmospheric conditions, and the amount of pollen present in the air.

Ætiology.—Hay fever exists in Europe and North America, and it is especially common in England, where the number of cases is annually double that of any other country. The Anglo-Saxon race appears more liable to it than other races. It prevails more among men than women, probably because the former are most exposed to the atmosphere; and inhabitants of towns visiting the country are more liable to attack than the country-people themselves. Dr. J. N. Mackenzie of Baltimore assigns hay fever to an exalted condition of the nasal erectile tissue, and especially the portion covering the posterior end of the inferior turbinated bone and the septum immediately opposite, rendering it more sensitive to the action of pollen and other irritants; and he maintains that destruction of this erectile tissue by the galvano-cautery cures the disease.

It has been ascribed by some writers to the sun's heat in the summer months, also to certain odours, vegetable and animal; but the experiments of Mr. C. H. Blackley show it to be due to the specific influence on certain mucous membranes of the pollen-grains of the following natural orders of plants: Ranunculaceæ, Papaveraceæ, Fumariaceæ, Cruciferæ, Violaceæ, Caryophyllaceæ, Geraniaceæ, Leguminosæ, Umbelliferæ, Rosaceæ, Liliaceæ, Compositæ, Graminaceæ, and others, both exotic and native. Different kinds of pollen were applied to the mucous membrane of (1) the nares, (2) larynx, trachea, bronchial tubes (by inhalation), (3) conjunctivæ, (4) tongue, lips, and fauces; and in all these cases it produced the symptoms of hay fever, the pollen of grasses being most potent. Amongst these, secale cereale, or rye, exercised most marked effects, though greater influence is generally attributed to anthoxanthum odoratum.

It has been found that large quantities of pollen float in the air during the summer months; and that the number of cases of hay fever depends on the amount present, which increases in warm damp weather, decreases when it is very dry and hot, and often nearly disappears after heavy rain. Cold weather reduces the number of sufferers by checking the inflorescence of plants. The higher strata of the atmosphere appear to contain more than that immediately overlying the soil; and Mr. Blackley found the greatest number of pollen particles at between 1,000 and 1,500 feet above the earth's surface, whither they are probably carried by aërial currents. The number of pollen grains present reaches its maximum in June, when Mr. Blackley collected 880 in a day on a square centimetre of glass. The size and forms of the pollen grains vary greatly in the different species, but this does not seem to influence their action, which appears to depend on the pollen sac absorbing moisture from the contiguous mucous membrane and bursting, when the minute granules it contains are thus extruded, and cause irritation.

Symptoms.—An attack of hay fever generally occurs without any premonitory disturbance, immediately on the application of the pollen to the mucous surfaces—for instance, when the person enters a hay-field. The first symptoms are itching of the parts with which the particles come in contact, beginning with the hard palate and fauces, and then extending to the nostrils, the eyes, and face, though, if the wind be strong, the eyes may be first attacked. The catarrhal stage follows, marked by violent fits of sneezing, and running from the eyes and nose, with occasional pains in the head and in the frontal sinuses; then the submucous tissue of the nares swells; and in a short time both nostrils become blocked and impervious to air. A change to the recumbent position, however, if the patient lies on one side, will often re-open the uppermost nostril, while the other, as the result of gravity, becomes still more occluded. The sneezing will continue without fresh application of pollen, as at night, when the subsidence of the swelling restores, or even exaggerates, the sensibility of the Schneiderian membrane. The alæ nasi become red and inflamed, and occasionally bleed. The discharge after this becomes less in quantity, inspissated and puriform, and finally subsides. In the eyes, the swelling of the submucous tissue causes closure of the lachrymal canals and nasal ducts; and considerable injection of the conjunctival capillaries is apparent. Sometimes, but rarely, œdema of the eyelids follows. Similar to the nose-symptoms are those occurring in the throat, some swelling taking place in the pharynx, which gives rise to partial closure of the Eustachian tubes, and hence to a certain degree of deafness. Slight feverishness is occasionally present, the pulse quickening to 100, and the temperature slightly rising; but in a large number of cases pyrexia is entirely absent. The changes which take place in the mucous membrane of the air-passages give rise to asthmatic symptoms, such as tightness of the chest, difficult and wheezy breathing, with prolonged expiration, and some dry cough, followed, at the close of the attack, by expectoration.

The catarrhal symptoms are, however, more characteristic than the asthmatic, which are not invariably present.

The liability to attack lasts generally from three to four weeks in summer, but its duration depends on the presence of the exciting cause, which, if not removed, may cause the malady to last for months. A fall of rain will diminish the disorder by clearing the air of pollen; exercise, which increases the number of respirations and, therefore, of pollen grains inspired, will render it more severe; while each attack makes the individual more susceptible to this subtle influence, and consequently augments the probability of other seizures. As a rule, hay fever has no complications, and passes away completely on the removal of the exciting cause. Constant recurrence of the attacks has been noticed to lead to deafness, owing to catarrh of the Eustachian tubes.

Diagnosis.—The diagnosis of hay fever from other affections is easy, as the fact of the catarrhal symptoms occurring only in summer separates it from an ordinary 'cold in the head'; while their combination with dyspnœa in hay fever prevents it being mistaken for spasmodic asthma arising from other causes, in which there is usually no catarrh.

Prognosis.—The prognosis is favourable if the patient be removed from the exciting cause, as the asthmatic symptoms seldom, if ever, lead to pulmonary emphysema, or to any permanent change in the bronchi.

Treatment.—The most obvious course in the treatment of hay fever, but not always the most easy one, is to avoid exposure to pollen. Mr. Blackley notices that a small amount of this material might exist without giving rise to hay fever, but if ten particles of pollen were detected on the glass slide exposed to the air for twenty-four hours, symptoms were sure to appear in persons liable to it. Sufferers from this complaint should avoid hay-fields, hay-ricks, and much exposure and exertion in the country during the hay season, and should remain to a great extent within doors; but, where circumstances admit, change to the seaside is highly desirable, and it frequently effects a speedy cure. Even on the coast some care must be taken to select a locality free from vegetation; for if the wind blows from the land, and hay-grass be flowering at the time, an attack may be induced. Choice should be made of a seaside place backed by high cliffs, and where the prevailing winds are from the sea. Another method of avoiding attacks is by sea voyages or short yachting cruises, undertaken during the hay season, and many sufferers enjoy complete exemption in this way. Of other localities, high mountain stations, where there is more grazing than hay-growing, and closely inhabited cities with few parks or grassy squares, are to be preferred. Carbolised cotton-wool and other available respirators are sometimes used with advantage.

The medicinal treatment consists, first, in combating the general predisposition to the complaint by tonic measures; and, secondly, in allaying the local irritation.

The first object is best achieved by shower baths, and by such tonics as iron, quinine, nux vomica, sulphate of zinc, and arsenic. Lotions of sub-acetate of lead or sulphate of zinc applied to the eyes and inner surface of the nostrils give some relief; but the writer has found the most successful results from brushing the interior of the nostrils and pharynx with a solution of hydrochlorate of cocaine (20 per cent.) with a curved brush. Sir Andrew Clark strongly recommends the application of a combination of glycerine of carbolic acid, quinine, and perchloride of mercury to the floor of the nares and pharynx. Various sprays are exceedingly useful, such as those of solutions of carbolic acid (eight grains to an ounce), sulphurous acid (equal parts with water), sulphate of quinine (two grains, with acid, to an ounce), and tannic acid (four grains to an ounce); but the best of all is a solution of cocaine (8 to 10 per cent.), which reduces the sensibility of the parts affected. The spray may be applied, with proper precautions, to all the irritated surfaces—eyes, nose, throat, and larynx—with great relief.

C. Theodore Williams.

HEADACHE.—Synon.: Cephalalgia; Fr. *Douleur de tête*; Ger. *Kopfschmerz.*—Pain or uneasiness in the head is very variable in its nature, and is produced by a great number of causes. It is present at some period or other in the course of most acute, and many chronic diseases; and may be associated or not with organic change in the brain, or in other organs of the body.

Symptoms. — Headache presents many varieties. It may be slight or most intense; superficial or deep-seated. It may be more or less confined to particular parts, as the forehead, the temples, the occiput, or vertex. Sometimes the pain is limited to one spot, producing the sensation as if a nail were being driven into the head, when it is called *clavus.* It may extend over one side of the head, as in hemicrania, or megrim; or be generally diffused. Headache presents every variety of character—dull, sharp, cutting, &c. Its accession may be sudden or gradual; and the paroxysms may be of the shortest possible duration, or may extend over hours, days, or months. The pain may be simple, or associated with various perverted sensations, such as giddiness, tingling in the limbs, disordered hearing, or disturbances of vision.

Varieties.—For practical purposes headaches may be arranged in the following order:—

1. *Structural headache,* or headache dependent upon disease within the cranium.
2. *Congestive headache.*
3. *Nervous* or *sick headache*—hemicrania or megrim.
4. *Toxæmic headache.*

1. *Structural headache.*—This may be due to any of the many forms of disease of the brain, or of its membranes, such as meningitis, cerebral softening, abscess of the brain, cerebral tumour, &c.; or it may be premonitory of cerebral softening. It is nevertheless often wanting in these disorders, and the locality of the pain, when present, by no means corresponds with that of the lesion. As a rule, the pain of organic disease is fixed and habitual, though sometimes, as in abscess or cancerous tumour, it may be of an intermittent character. If there be sickness associated with it, the sickness occurs without any apparent gastric disorder, and the pain continues after the sickness ceases. Stooping, and even the recumbent posture, aggravates the pain, whilst it is lessened by elevating the head. If organic disease be suspected, the collateral symptoms must be carefully scrutinised and weighed. It rarely happens that organic disease needs to be inferred from pain alone.

2. *Congestive headache.*—Many forms of headache depend upon a greater or less degree of congestion of the vessels of the brain; the congestion being either active or passive.

Active congestion may be caused by hypertrophy of the left ventricle of the heart, general plethora, catamenial irregularities, mental or emotional excitement, and other conditions. The pain in such cases is of an obtuse character, affecting the whole or a part of the head, particularly the forehead and occiput. It is accompanied with a sense of pulsation in the ears, flushed face, glittering eyes, and giddiness on stooping.

Passive congestion may be produced by dyspnœa, by asthma, by valvular disease of the heart, or by disordered action of the liver, bowels, and skin; it may be an after-effect of drunkenness; or may result from any cause which can produce a state of debility in the vessels of the brain, such as general anæmia, exhaustion from fatigue, loss of blood, leucorrhœa, or that following over-excitement, mental exertion, or bodily fatigue—causes which all favour congestion. When the headache is induced by anæmia, debility, or indigestion, the pain occurs generally across the forehead or at the top of the head.

3. *Nervous* or *sick headache, hemicrania* or *megrim.*—This disorder is discussed in a separate article. *See* Megrim.

4. *Toxæmic headache.*—The headache which attends all fevers and inflammatory disorders, though due in some measure to cerebral congestion, is chiefly caused by the action of the blood, altered in character and elevated in temperature, on the nervous elements of the brain. In uræmia likewise the headache, which frequently precedes or accompanies the other symptoms pointing to the existence of renal disease, results from the morbid condition of the blood. So also, in some persons, breathing the impure air of a crowded room, or the products of the combustion of gas, will, by the imperfect decarbonisation of the blood, speedily produce a headache.

Diagnosis.—Besides the above varieties of headache, pain about the head external to the brain may be produced by *rheumatic* affections of the scalp, with tenderness of the skin and rheumatism in other parts; by *syphilitic* affections of the periosteum or bone; by *inflammation* of the scalp, commencing erysipelas, &c; and by trigeminal and other varieties of *neuralgia.* Headache may be discriminated from neuralgia by its mode of accession; by the generally longer duration of the attack; and by the more complete intermissions.

TREATMENT.—The treatment of headache must necessarily depend upon the peculiarities of each individual case. In organic or toxæmic headache, the disease with which it is associated, and not the symptom itself, will of course be the object of consideration, and the treatment will be found discussed in connexion with these special morbid states. The same remark applies to many forms of congestive headache, such as those produced by disease of the heart, asthma, &c. If catamenial irregularities or uterine disorders are the exciting cause, these must be treated by appropriate measures. If anæmia or debility be present, then, in the intervals between the paroxysms, iron in some form, either alone or in combination with quinine or some vegetable bitter, must be given. During the paroxysms a little sal volatile, a cup of soup or strong tea or coffee, or some weak alcoholic stimulant, may be of service. Where anæmia is not a prominent symptom, or when the disorder assumes a periodical or intermittent character, quinine alone, in doses of two or three grains twice or three times a day, may be given; and if this fails to afford relief, arsenic is often of signal service. Great benefit is frequently afforded in the latter cases by the careful administration of alcohol or other alcoholic stimulant during the paroxysm. Except when the headache is associated with general plethora or active congestion, strong purgatives are to be avoided, and the bowels are to be regulated by the mildest aperient which will answer the purpose. The patient's habits and mode of life must also be strictly regulated; and care must be enjoined as to diet, sleep, clothing, and exercise, especially if the headache be associated with dyspepsia. If dyspeptic symptoms are prominent, or if the pain be connected with a gouty diathesis, then these disorders must be treated with their appropriate remedies.

If during the paroxysms the head be hot and the face flushed, warm or cold lotions, iced water, or eau-de-Cologne may be applied; a warm douching may be useful in some cases. Occasionally in severe attacks a few leeches may be placed on the temples or behind the ears with advantage, or a blister to the nape of the neck, but never if the face be pale and the pulse feeble. Compression of the temporal arteries with a pad, sustained pressure around the head, or holding the arms high above the head, will sometimes relieve severe congestive headache.

The treatment of sick headache is discussed under the article MEGRIM.

P. W. LATHAM.

HEALING SPRINGS, in Bath County, Virginia, U.S.A.—Thermal waters. *See* MINERAL WATERS.

HEALTH, Maintenance of.—*See* DISEASE, Causes of; PERSONAL HEALTH; and PUBLIC HEALTH.

HEARING, Disorders of.—These disorders may be grouped under three classes, namely: (*a*) *Partial or complete loss of hearing,* or *deafness*; (*b*) *Exalted hearing* (so-called); (*c*) *Perverted hearing* or *tinnitus.* They may be due to various conditions quite independent of any actual disease of the auditory apparatus, and only such causes of disordered hearing will be considered in the present article as are not due to changes in the conducting portion of the ear, which can be demonstrated by the different methods of examination, or to recognised affections of the nervous apparatus connected with hearing. These will be found discussed under the article EAR, Diseases of.

(*a*) *Partial or complete loss of hearing.*—Perhaps the deafness due to accumulations of cerumen, which so frequently interfere for a time with the hearing of persons whose ears are free from disease, should be regarded as disordered hearing, rather than as a symptom of a pathological condition. As nothing more energetic than careful syringing is required to remove such obstructions, it will be sufficient to observe that in this proceeding the nozzle of the syringe should be directed along the roof of the external canal. Amongst a very large number of people with the organs of hearing in an apparently healthy state, some few will be found upon whom, throughout their lives, certain notes produce no response. They will not, for example, be able to hear the sounds made by grasshoppers, or the singing of some birds—the call of a partridge, for instance; and in most persons, as age advances, the very high notes are lost. To prove this, it is only necessary to blow one of Mr. Galton's whistles in a room full of people, when a considerable proportion of the assembly will fail to catch the high notes, which are distinctly heard by the rest; and although this failure is also noticeable in many nervous affections, all other sounds will perhaps be heard quite normally by these individuals. Emotional influences play a very large part in the destruction or suspension of hearing, and this is especially observable in the case of women. The unexpected sight of a dead husband, hearing of the death of a dear friend, the proposal of a severe surgical operation on a relative, a quarrel, an alarm of thieves, and witnessing a carriage accident, have each within the knowledge of the writer been followed by intense and sudden deafness, which has only been partially recovered from. The same effect has been noticed with men who have been subjected to prolonged mental strain, in connexion with literary work, or during commercial crises. It has been recorded that a deaf-and-dumb child has suddenly recovered hearing, after the discharge from the bowels of eighty-seven lumbrici and a large number of oxyurides (*Journ. of Med. Soc.*, 1844). Complete loss of hearing, extending over several months, was on one occasion followed by perfect hearing in a girl of fifteen, on the first appearance of menstruation. The temporary effect of quinine and salicylic acid on the hearing is well known, but when quinine has been administered in large doses, and for a long period, this special sense is not unusually injured permanently. Amongst the diseases which often induce a lasting deafness, without any perceptible local change in the conducting portion of the ear, may be included mumps, many of the fevers, and diphtheria; for although in the two latter instances the middle ear often suffers, this is not always the case, and the immediate cause of the deafness must be sought in the products of inflammation which have been left within the cranium. The same explanation is probably also the correct one in those instances where children lose for ever all hearing power after cerebral excitement or congestion. Habitual and obstinate constipation is sometimes attended with loss of hearing, which returns after the action of purgative medicine. A clot of blood within the cranium, whilst causing hemiplegia of the opposite side, may destroy the hearing on the same side as the effusion; and a case is on record in which closure of the cerebro-spinal foramen gave rise to this symptom.

(*b*) *Exalted hearing.* — What is termed 'exalted hearing' will generally, on careful examination, be found to be not so much a definite change in the capacity of the hearing apparatus to receive impressions, as an inability on the part of the patient to receive such impressions without an undue effect on the nervous centres being produced. Thus in many inflammatory states of the brain or its membranes this symptom is often a prominent one. It is also not uncommonly met with in hysterical and nervous persons.

(*c*) *Perverted hearing.*—Attendant on most of the above examples, and closely allied to deafness, is the often persistent tinnitus; but there are conditions in which this distressing symptom is the chief and solitary trouble. Thus tinnitus, with a feeling of pulsation in the ear, is occasionally the first warning of an intracranial aneurysm; whilst a furious tinnitus and the hearing of strange noises sometimes precede an attack of acute mania. Patients who have been the subjects of malarial fevers and sunstroke often complain of tinnitus; and as in all cases of disease of the ears, when present, it is the most intractable of symptoms, so it is when the ears have not been the seat of any malady or injury.

TREATMENT.—Since all the above states of disordered hearing may strictly be said to be due to causes which are in themselves abnormalities of one part or another of the organism, it is to these that the treatment will naturally be directed rather than to alterations in hearing which in truth are merely symptoms. *See* EAR, Diseases of; and TINNITUS. W. B. DALBY.

HEART, Diseases of.—The study of this class of diseases has reference to the immediate pathological changes which occur in the heart itself, and to the consequences or results of these changes upon its function, that is to say, upon the circulation of the blood. The latter portion of the subject will be found discussed in the articles which have reference to disorders of the special organs of circulation; and it will therefore be necessary in this place to summarise only the morbid changes which affect the heart itself, and this merely as an introduction to the full description of those changes contained in the following articles, or which will be found in other parts of this work.

1. The heart may be *displaced*, *misplaced*, or *malformed.* 2. Its various textures, including the coverings, the lining membrane, the valves, and the walls, are liable to *acute* and *chronic inflammation* and their effects. 3. The organ itself as a whole may be increased in size, either by general *dilatation* of one or of more of its cavities, or partially, as by *aneurysm* of the walls; or by an addition to its volume, by *hypertrophy* of its *muscular* structure, of the *fatty* tissue which exists beneath the pericardium, or of the *connective tissue* which binds the muscular fibres together. 4. Its volume may be diminished by simple or general *atrophy*; or by the walls of one or more of its cavities being wasted and thinned. 5. Its walls are liable to various forms of *degeneration*—more especially *fatty*, *granular*, *calcareous*, and *pigmentary.* 6. They may be the seat of *fibroid disease*, and of various *morbid growths*, such as *cancer*, *tubercle*, *syphilitic formations*, or *hydatids.* 7. *Congestion* and *hæmorrhage* may occur in the walls of the heart. 8. These are liable also to such injuries as *rupture*—whether spontaneous or as the result of violence; and to various kinds of *wounds* and their effects. 9. The nervous apparatus of the heart may be affected, as in angina pectoris. 10. And, lastly, the reader will find discussed under the head of *functional disorders* of the heart, certain disturbances in its action and sensibility which cannot be clearly referred to any distinct lesion. RICHARD QUAIN.

HEART, Abscess of.—*See* HEART, Inflammation of; and HEART, Pyæmic Abscess of.

HEART, Aneurysm of.—Definition. A simple depression or a sacculus formed in the walls of the heart, and communicating by an orifice, varying in size, with one or more of its cavities.

The term 'aneurysm of the heart' has not been always used in this sense. It was first applied by Lancisi and subsequently by Bouilleau to any dilatation of the heart, whatever its cause or its character. Cases of the disease, as the term is now understood, were published by Galeatti and John Hunter in 1757. In this country, Dr. Thurnam, Dr. Peacock, more recently Dr. Wickham Legg, and others have treated the subject fully. In France aneurysm of the heart has been described specially by Breschet and by Pelvet; whilst in Germany, Lobstein, Löbl, and Hartmann have written upon it at length. A full account of the researches of these and several other writers will be found in the work of M. Pelvet—*Des Anévrysmes du Cœur*, Paris, 1867—and in the Bradshaw Lecture at the Royal College of Physicians by Dr. Wickham Legg.

Ætiology and Pathology.—The essential condition which leads to aneurysm of the heart is a change in a portion of the heart's texture, by which the resisting power of the affected part against the pressure of the blood from within the cavity is diminished. Under such circumstances a simple depression, corresponding to the weakened spot, may be first formed on the inner surface of the heart. This gradually extends through the cardiac wall towards the external surface, where the resistance becomes less, and where a pouch or sac is then formed, communicating with the cavity of the heart, it may be by a neck. The weakened condition referred to is attributable in different instances to inflammation of the substance of the heart, whether acute or chronic; to syphilitic or other growths; to fibroid and to fatty degeneration.

(*a*) *Inflammation* of the heart, affecting either the endocardium or the substance of the heart itself, may lead to softening and ulceration; and both conditions have been found in connexion with aneurysm. Inflammation may also lead to the formation of pus in the walls of the heart; and cases are recorded in which, the contents of the sac thus formed having been discharged into the circulation, the cavity became converted into an aneurysmal pouch (Dr. Wilks, *Path. Soc. Trans.*, vol. xii.) Cases of aneurysm of this character may be regarded as originating in *acute* inflammation of the heart.

In a still larger number of cases, in which the endocardium and pericardium, as well as the muscular walls, are involved, we find a development of fibroid tissue—a cirrhosis, as it were, of the wall of the heart, as the result of *chronic* inflammatory action, and as some writers suppose of disease of the coronary arteries. In these cases the fibroid tissue is stretched at each systole of the heart, and it returns less and less to its former dimensions, owing to its want of elasticity. Thus by degrees the portion of the heart affected yields and is pushed outwards, forming a sac of a more or less globular shape.

(*b*) *Growths* in the heart, whether syphilitic or tuberculous, undergoing the process of softening, may lead to the formation of aneurysm, as in the conditions just described.

(*c*) *Fatty degeneration* may give rise to the formation of aneurysm. First, a circumscribed portion of softened tissue in the wall of the heart, the result of fatty degeneration, yields without rupture to the pressure of the blood from within, and thus allows of the formation of an aneurysmal pouch. Secondly, partial rupture may take place in the muscular wall, and, hæmorrhage occurring at this point, constitutes what is called 'cardiac apoplexy' (*see* Heart, Hæmorrhage into the Walls of). The clot thus formed undergoes the changes usual in extravasated blood; and a cyst results, which may ultimately communicate with one of the cavities of the heart. Meriedec Laennec, who wrote on aneurysms of the heart, believed that this form of disease was almost exclusively thus developed.

With reference to the relative frequency of the various causes of cardiac aneurysm just enumerated, the writer finds that out of a total of 56 cases, the histories of which were collected by himself, in 21 the walls had undergone fibroid changes, which may have occurred before or during the progress of the aneurysmal formation; in 6 there was fatty degeneration; in 3 the disease was the result of ulceration; in 2 cases it appeared to have originated in abscess; and in 24 the materials were not sufficient for arriving at an accurate conclusion.

Age.—With regard to the age at which this disease occurs, in 62 cases collected by the writer the oldest was eighty-two, the youngest a child of twelve. Three cases occurred between ten and twenty years of age, 10 between twenty and thirty, 14 between thirty and forty, 10 between forty and fifty, 7 between fifty and sixty, 10 between sixty and seventy, 6 between seventy and eighty, and 2 between eighty and ninety years of age.[1]

Sex.—Of 62 cases, 45 were males and 17 were females.

Anatomical Characters. — Keeping in view the several conditions under which aneurysm of the heart can occur, we may expect to find a corresponding variety of morbid appearances. On laying open the pericardium in cases in which aneurysm of the heart exists, adhesions which are more or less universal, or which may be limited to the seat of the disease, are very frequently found. The heart itself is generally enlarged; and where the aneurysm projects externally it is altered in shape, so much so in some instances that the organ looks like a double heart. The sac may project from the walls as a rounded or conical tumour; or, as in an instance that came under the notice of the writer, it may assume the appearance of an elongated sac winding round the base of the aorta. Again, nothing abnormal may be observed until the heart is laid open, when a depression or an opening may be discovered in the walls of the ventricle, or in the septum. In some instances more than a single pouch is formed: there may be several, each communicating with the cavity of the heart by a separate or by a common opening. The size of the tumour may vary from that of a bean to that of an average-sized cocoa-nut. The opening leading into the pouch may be the widest part of the sac, the aneurysm being a mere depression like a watch-glass or half an egg; or there may exist a constricted or defined neck, leading to a tumour bulging from the walls. The size of the opening may vary from a couple of inches across, to one capable of admitting only a probe. The neck is, in a few cases, described as hard and cartilaginous; in others, as being smooth and regular, or jagged and irregular. The walls of the tumour may be formed by the dilated and thin walls of the heart; or by the walls considerably thicker than natural, and altered in texture. A very usual condition to find is that the walls of the sac consist, proceeding from within outwards, of endocardium; of fibroid tissue, with or without portions of muscular tissue; and of pericardium. This condition was described as occurring in 11 cases. In 8 cases the walls were said to consist only of the endocardium and pericardium, with fibroid tissue between; but it was found that at the base of the tumour, in all these cases, all the layers of the heart-tissue were present, and that it was only towards the apex of the swelling that the muscular layers disappeared. In 3 cases the walls of the aneurysm were said to be composed of a thin membrane, which appeared to consist of endocardium and pericardium only. In 3 cases the walls were of cartilaginous consistence, with bony plates interspersed in the tissue. The thickness of the walls of the sac varied from that of paper to three lines or more. In 14 cases the wall of the tumour was strengthened by an adherent pericardium. The aneurysmal cavity in the majority of cases was lined by smooth membrane; but in a few instances, apparently of acute formation, the walls consisted of muscular fibres, torn and separated by the blood which had been extravasated amongst them. The contents of the sac are generally in the form of blood-clots or layers of fibrin, the outermost layers of which may be more or less organised and adherent to the wall.

---

[1] Sacs connected with the cavities of the heart have been found at birth occasionally. They must be regarded as malformations.

Seat.—Of the 56 cases already alluded to, 52 were in the left ventricle, 3 in the right ventricle, and 1 in the right auricle. Of the 52 cases in which the aneurysm was situated in the left ventricle, 22 occupied the apex, 11 the base, and 17 were in intermediate situations. Several cases have been recorded in which the aneurysm was situated in the muscular septum between the ventricles; in the 'undefended space;'[1] or at the base immediately below the aortic valves. A case of the last-named form was recorded by the writer in the third volume of the *Transactions of the Pathological Society.* These two last forms are generally associated with endocardial inflammation and ulceration.

SYMPTOMS.—In 13 of the 56 cases referred to, the aneurysm was not discovered until after death; no mention being made of signs or symptoms of its previous existence. In the remaining cases, symptoms, more or less marked, indicative of heart-disease, were present. These symptoms were chiefly—pain, dyspnœa, lividity of the surface, palpitation, and irregularity of the pulse. In 10 cases murmurs were heard, accompanying or replacing the sounds of the heart. We thus see that the symptoms of aneurysm are such as may exist in common with other lesions of the heart; and it is extremely doubtful, except in presence of some special circumstances indicative of this condition, whether we have at our command the means of diagnosing the existence of cardiac aneurysm. The writer not long since saw, with Dr. Holman, late of Reigate, a case of grave heart-disease, in which extended dulness to the left, and below the usual situation of the apex-beat, with a feeble impulse in the same situation, led to a suspicion of the probable existence of cardiac aneurysm.

PROGRESS, DURATION, AND TERMINATIONS.—Pathological testimony fully justifies the inference that certain cardiac aneurysms—such as those which originate in inflammatory softening, ulceration, or the opening of cysts into the cavities of the heart—are acute in their formation. But the like evidence further testifies that the formation of most other aneurysms, and the progress of all, are of a slow or chronic character. Still it would seem to be difficult, if not impossible, to determine the duration of the disease in any given instance, inasmuch as many cases, for example, have been found in the *post-mortem* room, which had not given rise to any special symptoms; whilst in other cases the pre-existence of heart-disease before the formation of aneurysm rendered it equally impossible to fix a date for the development of the latter special disease.

---

[1] A case of this character, apparently congenital, was described by Dr. Angel Money in a child five years old. See *Path. Soc. Trans.*, vol. xxxviii. p. 97.

Death may result from the disturbance of the heart's action, induced by the presence and the extent of the disease; from the aneurysm opening into the pericardium; or from its burrowing in the wall of the heart, and opening into another cavity of the organ different from that in which it originated. Lastly, one or two cases are recorded in which a cure of the disease had apparently been effected by the walls of the sac becoming indurated or calcified.

Diagnosis and Prognosis.—Seeing how extremely obscure the clinical history of these cases is, it would be impossible to speak more definitely either as to the diagnosis or the prognosis of the disease than has been done under the preceding head.

Treatment.—The treatment of cardiac aneurysm must be such as would be adopted in any other form of grave heart-disease, and according to the special circumstances of, and indications in, each case. We can only seek to mitigate the more urgent symptoms, whether local in the heart itself, or more generally affecting distant organs.

Richard Quain.

HEART, Apoplexy of.—*See* Heart, Hæmorrhage into the Walls of.

HEART, Atrophy of.—Definition.—A diminution in the size and weight of the heart as a whole; or a diminution in size of one part of the heart in relation to the whole organ.

Ætiology.—The causes of atrophy of the heart are either *general* or *local.* With respect to the *general* causes of atrophy, the heart is found reduced in volume together with the other organs of the body, in cases of marasmus, of phthisis, of syphilis, cancer, &c. Probably one of the smallest hearts on record—one which weighed but $3\frac{1}{16}$ ounces—was found by Dr. Church in the body of a woman aged forty-seven, who died of cancer of the pylorus, after an illness characterised by 'gradual starvation' of more than seventeen months' duration. With reference more especially to phthisis, as affecting the size of the heart, an analysis of 171 cases, made by the writer at the Brompton Hospital, showed that this organ was below the average weight in 54·4 per cent. Diseases of a sub-acute character, such as typhoid fever when protracted in its course, may lead likewise to wasting of the heart. The heart is also occasionally congenitally small.

The *local* causes of atrophy of the heart are chiefly two—namely, (1) pressure by pericardial adhesions upon the heart, by mediastinal tumours, by fatty growth beneath the pericardium, and other like conditions; and (2) interference with the circulation in the coronary arteries, as in the conditions just enumerated, or as a result of malformation or of disease of the vessels themselves.

Partial atrophy of the heart, when it occurs, may be said to be referable to insufficient blood-supply from vascular disease or from local pressure; or from fatty infiltration.

Anatomical Characters.—The heart in simple atrophy presents a general uniform diminution in size, as regards both its walls and its cavities; and in its weight. In local atrophy, a portion of the cardiac wall, more or less extensive, or of one of the divisions or cavities of the heart, may be found to be below the ordinary dimensions. The colour of the atrophied heart may be normal; it is frequently pale; and it is occasionally of a deep reddish-brown. The pericardium, not shrinking proportionately with the muscular substance, may present a puckered, opaque, and œdematous aspect, 'like a withered apple' (Laennec); and for the same reason the coronary vessels may be tortuous and prominent. The consistence of the walls is generally firmer than natural; and the muscle may be even tougher, except where the atrophy is due to the presence of fat, in which case the fibres are friable, and on microscopical examination present the appearances of fatty degeneration. In *simple* atrophy of the heart, the muscular fibres undergo diminution in volume; and they may also be actually reduced in number. Atrophy of individual muscular fibres is also found as the result of interstitial fatty or fibroid growth; and this when extensive has been somewhat erroneously named '*yellow* atrophy.' Another variety, which is most frequently found in the marasmus of old age, is known as *brown* atrophy of the heart. In such cases the muscular tissue is of a dark or dirty reddish-brown colour, which proves on microscopical examination to be due to the presence of numerous shining yellow or brown pigment-particles within the muscular fibres, and specially abundant either around the nuclei or between the ultimate fibrillæ.

Symptoms.—The symptoms and signs of atrophy of the heart are those which might be expected to result from diminished size and power of the organ. The characteristic phenomena are those of feeble circulation. The physical signs are chiefly diminished præcordial dulness; a feeble impulse, the apex-beat being within and above the usual situation; diminished area of audible sounds; and a small, weak pulse.

Diagnosis.—The above signs and symptoms, in association with general wasting, afford sufficient grounds for the diagnosis of atrophied and feeble heart. Emphysema, pericardial effusion, and other causes of diminished cardiac dulness and weakness of impulse, must be excluded by the ordinary modes of investigation. There are no special means by which *partial* atrophy of the heart can be diagnosed, except, possibly, that the presence of this condition may be assumed where the functions of the organ are disturbed in the absence of valvular or other of the more common forms of cardiac disease, sufficient to explain the symptoms.

TREATMENT.—The treatment of atrophy of the heart is the treatment of the primary disease upon which it depends, so far as is possible. RICHARD QUAIN.

HEART, Calcification of.—*See* HEART, Degenerations of.

HEART, Cancer of.—*See* HEART, Morbid Growths in.

HEART, Cirrhosis of.—*See* HEART, Fibroid Disease of.

HEART, Congenital Misplacement of.—SYNON.: *Ectopia Cordis* (Breschet); *Ectocardia* (Alvarenga).

The heart is occasionally found to occupy a wrong position, and such misplacement may be either within the cavity of the thorax, or external to it.

1. Of the *internal* malpositions—*ectopia cordis intrathoracica* or *ectocardia intrathoracica*—the most common is that to which the term *dexiocardia* has been applied, in which the heart is in a very similar position on the right side of the chest to that which it should occupy on the left. This condition may coexist with transposition of the other viscera of the body, or it may occur alone. Instances of the former kind have long been placed on record, cases having been met with in Rome in 1643, in Paris in 1650, and in London in 1694. When the heart is misplaced, the aorta generally follows an irregular course, crossing the right bronchus and passing down to the right side of the bodies of the vertebræ; and the right carotid and subclavian arteries are given off as separate vessels, while the brachio-cephalic trunk is situated on the left side. In some instances, however, the vessels at the arch are not transposed; whilst in others the aorta, after passing over the right bronchus, crosses the spine and follows its usual course to the left of the bodies of the vertebræ. In cases of transposition the heart itself may be well-formed; or it may be very imperfectly developed.

In another kind of misplacement, *mesocardia*, the heart is situated more in the median line than natural—a position which it occupies in the fœtus at the earlier periods. Cases have also been recorded in which the organ occupied a transverse, and an antero-posterior direction.

2. Of the *external* misplacements, those in which the heart is situated external to the thoracic cavity—*ectopia* or *ectocardia extrathoracica*—the most common is that in which, from deficiency of some part of the sternum, the organ lies in front of the chest—*ectopia cordis* or *ectocardia pectoralis*. In other cases, from deficiency in some portion of the diaphragm, the heart is placed in the abdomen, either lying in the cavity, or, if the integuments are partially defective, in a sac in the præcordia—*ectopia cordis* or *ectocardia abdominalis*. In a third form the heart lies at the root of the neck—*ectopia cordis* or *ectocardia cephalica*. Of these forms, examples are related or referred to in the memoirs of Breschet and Alvarenga, and various others have been published since the appearance of the memoir by Breschet.

SYMPTOMS, DURATION, AND TERMINATIONS.—When the heart is well-formed, its malposition within the thorax does not necessarily cause such interference with its functions as to be productive of symptoms, or materially to curtail the duration of life. Indeed, cases are on record in which the heart and other viscera have been transposed in persons who had never presented any signs of disorder of the circulation, and who lived to very advanced ages. When, however, the organ is also defective, and especially when the displacement is external to the thoracic cavity, life is usually only of short duration—though some remarkable cases of external displacements are on record, in which the patients survived to advanced ages.

Malformation of the Pericardium.—Closely allied to the cases of misplacement of the heart are those in which the organ, though occupying its natural position, is not covered by the pericardium, but lies in contact with the lung in the left pleural cavity. Of this form of anomaly various instances are recorded—the first undoubted case of the kind being probably that represented by Dr. Baillie, in 1778. The defect seems to consist in the pericardium, which is apparently reflected from the external coat of the aorta, not being prolonged so as to cover the front of the heart and become attached to the diaphragm. The imperfectly developed membrane is represented by a kind of loose fold, or pocket, which is found on the right side or upper part of the heart.

EFFECTS.—This condition does not seem materially to interfere with the functions of the organ. Cases are recorded in which the subjects lived to middle age; and the writer has himself seen it in a man who died of heart-disease at seventy-five.

T. B. PEACOCK.

HEART, Congestion of.—Attention was first directed to this morbid condition of the heart by Sir William Jenner (*Med.-Chir. Trans.*, vol. xliii., p. 199). The coronary veins, like the veins of other parts, are subject to engorgement when the flow of the blood from them into the right auricle is interrupted. The most common cause of this interruption is dilatation with distension of the cavities of the right side of the heart, which conditions are themselves usually due either to emphysema or to valvular disease of the heart. Disease of the trunks of the coronary veins and pressure upon them may be regarded as less frequent causes of cardiac congestion.

Post mortem, congestion of the heart is recognised, when recent, by fulness of the veins on the surface of the organ; by œdema of the loose connective tissue at the base; and ecchymosis of the pericardium and endocardium. The pericardial sac contains some serous or sero-sanguinolent effusion; and the mouth of the coronary sinus may be found to be dilated. When the congestion is slight, gradually developed, and of long standing, the venous fulness gives rise to an increased formation of connective tissue in the walls of the heart, which become, in consequence, tough and indurated; whilst the dilatation of the cavities, with which the congestion is associated, is rendered permanent by the same cause. When divided with the knife, the cardiac walls do not fall inwards; their substance feels like a piece of leather; and the section has a smooth homogeneous appearance. Microscopically, the connective tissue seems to be increased in quantity; and the muscular fibres are in a condition of granular, fatty, and pigmentary degeneration.

Congestion of the heart possesses no direct clinical relations; but its existence should never be overlooked in estimating the effects on the circulation of mechanical congestion, which must impair the functional activity of the heart in the same way as it impairs that of the liver, stomach, and kidneys.

J. MITCHELL BRUCE.

HEART, Connective-Tissue Hypertrophy of.—SYNON.: False Hypertrophy.

DEFINITION.—An excessive development of the connective tissue which exists between the muscular fibres of the heart, causing an increase in the size of the organ.

ANATOMICAL CHARACTERS.—In connective-tissue hypertrophy the heart is enlarged more or less uniformly as regards the walls of its several cavities, and usually to a great extent, the organ weighing in some instances as much as forty ounces. The thickness of the walls is increased, as in simple or true hypertrophy; their density and consistence are such as to present a firm, tough, leathery character. When cut the edges do not collapse, but continue stiff and prominent. The colour of a heart in this condition may vary from pale buff to deep purple, according to the amount of connective tissue, and of blood present in the vessels. Microscopically there is seen—not the usual limited amount of intermuscular fibrillar tissue and connective-tissue cells, but a decided hyperplasia of these elements, in the form of connective-tissue, of which all stages of development may sometimes be observed, from the round and spindle-shaped cell to the complete bundle of fibrillæ. Between the individual bundles of this tissue lie the muscular fibres, which are also hypertrophied, but which are more or less compressed, and are occasionally in a condition of granular or fatty degeneration (fig. 59).

There is a certain amount of anatomical resemblance, but a very clear pathological distinction, between this form of heart-disease and the change described by Sir William Jenner as fibroid disease of the heart resulting from congestion (*see* HEART, Congestion of). Connective-tissue hypertrophy may also to some extent be compared with the fibrosis described by Sir William Gull and Dr. Sutton as existing in the walls of arteries and other tissues.

ÆTIOLOGY.—Cases of hypertrophy of the heart have been described by several writers which were remarkable for the absence of disease of the valves, or of the blood-vessels, or of the kidneys, which, if present, could explain its origin, but which the writer believes were due to the morbid change above described, and not to hypertrophy of the muscular fibres alone. A remarkable specimen is preserved in the museum of St. George's Hospital, consisting of a heart weighing forty and a-half ounces, which was removed from the body of an under-butler, in the *post-mortem* examination of whom nothing was found which could satisfactorily explain the occurrence of the enlargement. The writer is indebted to Dr. Whipham for an opportunity of examining this specimen, which was found by his friend, Dr. Mitchell Bruce, to possess the microscopical characters above described and figured (fig. 59). This and similar cases exhibit no appearance of chronic inflammatory action, and thus differ altogether from examples of that form of fibroid degeneration which is described under a separate heading (*see* HEART, Fibroid Disease of). In the cases now described there is a simple hyperplasia of connective tissue, the origin of which cannot be fully explained. In Germany a similar enlargement of the heart

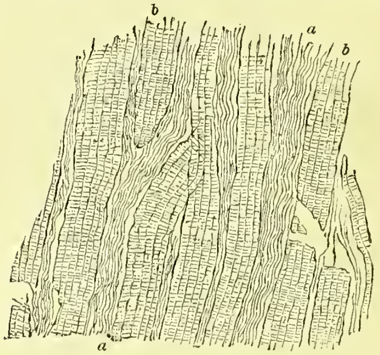

FIG. 59.—Connective-tissue Hypertrophy of the Heart.—*a a*, Connective-tissue fibrillæ. *b b*, Muscular fibres. × 250.

is said to have been found more especially in *gourmands*, and hence it derived a characteristic appellation. The existence of connective-tissue growth being thus determined, the effect of its presence on the muscular tissue is obvious. The connective tissue, surrounding, as it must do, the muscular fibres, interferes with their free action, to overcome which there will be a natural tendency to increased action, and consequent hypertrophy of the muscular fibres themselves. It is very probable that it is to these two processes going on simultaneously that the great increase in the size of the heart is due.

Symptoms and Diagnosis.—In a remarkable case recorded by the late Dr. Hyde Salter, which the writer believes to have been of the nature here described, acute or severe cardiac dyspnœa and hæmoptysis, from which the patient had suffered for several weeks, were the most prominent symptoms. The heart-sounds were natural, except that the first was dull and defective. The pulse was 84. The symptoms increased in severity, and were aggravated by excessive epistaxis. The patient died after being in hospital for fourteen days. At the *post-mortem* examination the heart was found to be of great size, and there was no disease either of the valves or of the vessels or of the kidneys to account for this. In the case of the butler in St. George's Hospital, it is recorded that he continued going about until within a few days of his death. These and some like cases indicate that we can do little in the way of diagnosis beyond recognising the presence of cardiac hypertrophy by the usual signs; and if the hypertrophy be considerable, and if there be no valvular disease and no kidney-disease, we might not be far wrong in considering that the hypertrophy was caused by increase of some other element as well as that of the muscular fibres.

Treatment.—If the opinion be correct that this form of disease finds its origin in excessive alimentation, it would be well to place the patient in such circumstances as would prevent this, giving attention at the same time to other hygienic conditions. The more aggravated symptoms of cardiac disease must be treated on general principles.

Richard Quain.

HEART, Coverings of, Diseases of. *See* Pericardium, Diseases of.

HEART, Degenerations of.—The degenerations that affect the heart may be enumerated as follows: (1) Fatty; (2) Parenchymatous; (3) Albuminoid; (4) Pigmentary; (5) Cartilaginous; (6) Calcareous; and (7) Vitreous. The condition which has been called 'fibroid degeneration' of the heart is described under the heads of Heart, Fibroid Disease of; and Heart, Syphilitic Disease of.

1. Fatty.—This form of degeneration of the heart being of special importance is discussed in a separate article. *See* Heart, Fatty Degeneration of.

2. Parenchymatous.—Synon.: Granular Degeneration; Cloudy Swelling; ? Parenchymatous Inflammation.

Ætiology.—This form of degeneration of the heart is generally met with in the acute specific fevers, especially typhus, and typhoid fever, diphtheria, and septicæmia; and is probably referable to the action either of the poison or of the high temperature attending the disease-process upon the muscular substance. *See* Degeneration.

Anatomical Characters. — The disease generally attacks the heart as a whole. The organ appears somewhat enlarged, extremely soft—flabby as well as friable, and of a dirty greyish-red colour. The pericardium is ecchymosed, dull, and swollen, and the epicardial fat has more or less completely disappeared. Microscopically, the muscular fibres are found to be dull and granular, swollen, and variously ruptured; their striations are indistinct; and the addition of acetic acid removes many of the granules from the fibres, whilst it brings more distinctly into view a few fatty globules, and frequently an increased number of pigment-particles.

Symptoms.—Inasmuch as parenchymatous degeneration of tho heart is usually but a complication of some acute specific disease, the condition of the patient is one of great febrile prostration with cardiac asthenia. The physical signs, which are regarded as more distinct evidence than the symptoms of the condition of the heart, are—feebleness, advancing to complete absence, of the apex-impulse, or more rarely palpitation; and progressive weakening, and finally loss of the first sound. The pulse has been described as corresponding with the condition of the heart, indeed in some cases it is imperceptible although associated with cardiac palpitation.

Course and Terminations.—The course and terminations of granular degeneration of the heart are inseparable from those of the primary disease. In typhus the average date of the appearance of the symptoms and signs just described is the sixth day of the fever; and they usually cease on the fourteenth day, but a large proportion of cases prove fatal before that time.

Prognosis.—The existence of this kind of degeneration of the heart adds seriously to the gravity of a case of fever; and the danger increases with the rate and weakness of the pulse, and the feebleness of the cardiac impulse and first sound. The re-appearance of the first sound under observation justifies a favourable prognosis.

Treatment.—The treatment of parenchymatous degeneration of the heart is in no respect different from that of the fever in which this condition originates. The appearance of the characteristic symptoms and signs of the cardiac affection is, however, to be regarded as an important indication for the use of alcoholic stimulants, which are, as a rule, well borne in such cases, and act very beneficially.

3. **Albuminoid.**—This kind of degeneration has been said, with a certain amount of possibility, to have been found in the heart. It is certainly excessively rare.

4. **Pigmentary.**— Pigment-granules, in the form of shining yellow particles, are almost invariably found in the muscular fibres of the heart in chronic cardiac disease. In certain cases of atrophy known as 'brown atrophy,' as well as in the granular degeneration just described, these pigment-particles are decidedly increased in number, and collected towards the axis of the fibres. A somewhat similar appearance is seen in the heart in jaundice.

The condition is of purely pathological interest.

5. **Cartilaginous.**—Portions of the myocardium have frequently been described as 'cartilaginous' or 'fibro-cartilaginous,' but it would appear that in these instances the muscular tissue was replaced by dense firm fibroid tissue only. *See* HEART, Fibroid Disease of.

6. **Calcareous.** — Calcification of pericardial adhesions is not very rare; and in some of the recorded instances of this condition, plates of the same material have been found projecting into the substance of the heart, appearing as if formed within the myocardium. Besides this class of cases, instances of true deposit of calcareous particles within the individual muscular fibres have been described. The change appears in the form of small, pale, gritty deposits, taking the place of the normal muscular tissue on the surface. On microscopical examination, the muscular fibres are found to have become solid and opaque, whilst hydrochloric acid or sulphuric acid removes the opacity with the evolution of gas, the addition of the latter acid also producing gypsum crystals. It is probable that, in other instances, the calcareous particles are situated outside the muscular fibres, and may be products of a caseous nodule, whether syphilitic or 'tubercular' in origin.

This form of disease appears to possess no special clinical relations.

7. **Vitreous.**—Vitreous, waxy, or colloid degeneration, as described by Zenker, occurs in the myocardium, as it does in the voluntary muscles.

J. MITCHELL BRUCE.

HEART, Dilatation of.—DEFINITION. Dilatation of the heart may occur in two forms. In the one it involves only a limited portion of the cardiac walls and constitutes an aneurysm; in the other there is uniform enlargement of one or more of the heart's cavities, and dilatation in the usual acceptation of the word is present. To this latter condition, however, the names 'aneurysm' and 'passive aneurysm' of the heart were formerly applied. Dilatation is probably always associated with hypertrophy.

ÆTIOLOGY.—The occurrence of dilatation implies that the walls of the heart which yield are too weak to resist successfully the internal pressure to which they are exposed. This defective relation may be due either to actual enfeeblement of the heart's walls, which renders them unequal to the task normally devolving on them; or to excessive blood-pressure, which even the healthily constituted walls are unable to withstand. The enfeeblement of the heart may be a consequence of fatty or other degeneration; or, as is probably more frequently the case, may be inherent but unconnected with visible textural disease. The excessive blood-pressure may be dependent on actual obstruction to the circulation, which the heart is called upon to surmount; or on undue rapidity of action, which (other things being equal) implies an unwonted expenditure of force. As a matter of fact, however, dilatation and hypertrophy are generally if not always associated; and the processes by which these combined conditions are attained are more complicated than the foregoing statement might lead one to suppose. It will be convenient, therefore, to consider certain cases *seriatim.*

1. In obstructive disease at the aortic orifice; in general stricture of the minute systemic arteries, such as occurs in connexion with contracted granular kidneys; and indeed in all cases in which resistance is offered to the free discharge of blood from the left ventricle, progressive hypertrophy of the walls of that ventricle takes place. But the hypertrophy is complicated even from the beginning with dilatation. The hypertrophy, at any rate at first, is simply compensatory, and may be taken as a measure of the excess of resistance which the heart is called upon to overcome. The dilatation, however, is in no sense compensatory, and is probably to be regarded as a measure of the inability of the walls to cope successfully with the extra work required of them. It is, moreover, obvious that the occurrence of dilatation, by increasing the area of resistance to the endo-ventricular blood-pressure, increases *pro tanto* the muscular effort requisite for the propulsion of the blood into the aorta; and by enlarging the capacity of the ventricular cavity and consequently the amount of blood to be discharged from it, on that account also throws additional labour on the muscular walls of the ventricle. Thus the hypertrophy and dilatation react on one another; and the hypertrophy, which was probably at first simply compensatory of the mechanical obstacle to the discharge of the normal contents of the ventricle, ends by becoming—or

rather striving to become—compensatory not only of this but of the virtual weakness of the heart which dilatation entails.

2. In regurgitant disease at the aortic orifice, hypertrophy and dilatation of the left ventricle also take place. But in this case, while the hypertrophy probably reaches a higher degree of development than in simple obstruction, dilatation preponderates from first to last; and the ventricle attains larger dimensions than in perhaps any other form of disease. But to what are the hypertrophy and dilatation due in this case? There is no impediment to the escape of blood through the aortic orifice, and therefore *primâ facie* no need for compensative hypertrophy. There is no doubt that here hypertrophy waits on dilatation. The immediate effects of regurgitation are, that during diastole the ventricle becomes more rapidly and completely filled with blood than it does under other circumstances; that hence the subsequent contraction of the auricle tends to distend it unnaturally with blood; and that during the whole of this period the walls have also to sustain the backward pressure of the systemic arterial blood. The result is that, on the principles above enunciated, the walls of the ventricle have to encounter a larger area of pressure, and to expel a larger amount of blood, than natural, and hence are called upon to make excessive effort, and hypertrophy ensues. Thus the tendency to dilatation causes the tendency to hypertrophy; and both, acting continuously, promote the progressive increase in the capacity of the ventricular cavity and in the thickness of the ventricular walls.

It is probable in both cases, but more especially in the latter of them, that ere long the ventricle fails to expel the whole of its contents into the aorta at each contraction, and that the retention of this residual blood becomes an important factor in promoting dilatation.

3. The effects of continued violent action of the heart, whether caused by nervous influence or by muscular effort, are much the same as those of obstructive disease. For both increased rapidity of contraction and increased amount of blood to be expelled at each beat (other things being equal) imply increased expenditure of force; and the persistence of either or both of these conditions, therefore, the supervention of hypertrophy and dilatation.

4. The above discussion relates especially to dilatation and hypertrophy of the left ventricle. But, *mutatis mutandis*, it applies with equal force to dilatation and hypertrophy of the other sections of the heart. Thus, in mitral valve disease, the left auricle undergoes hypertrophy and dilatation—the dilatation preponderating in regurgitant disease of the valve, the hypertrophy preponderating in obstructive disease.

5. In pulmonic valve disease the right ventricle becomes hypertrophied and dilated—the dilatation being greatest where there is pulmonic regurgitation, the hypertrophy being greatest where the disease is obstructive.

6. In tricuspid valve disease the right auricle suffers, becoming chiefly dilated in the presence of tricuspid regurgitation, chiefly hypertrophied when there is obstruction. And thus, also, just as when the systemic circulation is impeded the left side of the heart suffers, so when the pulmonic circulation is obstructed, the right side of the heart undergoes enlargement.

In all cases, therefore, hypertrophy and dilatation seem to result concurrently; but whether the one or the other condition preponderates, depends partly on the particular nature of the cause to which the hypertrophy and dilatation are due, partly on the inherent strength or weakness of the cardiac walls. In all cases, too, the other cavities of the heart, besides that primarily and directly implicated, suffer according to their position from the effects of the greater or less work which sooner or later is cast upon them. It may particularly be pointed out, that cavities situated behind the one primarily implicated tend sooner or later to share in its hypertrophy and dilatation, and that in cases of obstructive disease of either of the auriculo-ventricular orifices the corresponding ventricle, in consequence of receiving less than its due amount of blood, and of thus having less work thrown upon it, tends to undergo atrophy.

The temporary dilatation which is described as occurring in acute febrile disorders, such as typhus, is due mainly to enfeeblement of the cardiac walls.

Anatomical Characters.—In dilatation of the heart, the cardiac walls may be either thinner or thicker than natural, or may retain their normal thickness. It is a question, however, whether, excepting in the case of partial dilatation or aneurysm, dilatation ever takes place independently of hypertrophy; for even as regards the auricles, where dilatation with attenuation is chiefly observed, there is reason to believe that the attenuation is not commensurate with the extension which accompanies it, and consequently that the total bulk of muscular tissue is increased. When dilatation is associated with no apparent change in the thickness of the walls, hypertrophy is of course present.

It must be mentioned, however, that it is often very difficult to determine on *post-mortem* examination the true relation between the thickness of the cardiac walls and the capacity of the cardiac cavities. For their apparent relation is largely dependent on the condition of the cavities as to systole or diastole at the moment of death; and on the state of the heart as to cadaveric changes at the time of *post-mortem* examination.

The form which the heart assumes in dilatation is the same as that which it assumes in hypertrophy; and indeed, as the two conditions are probably always associated, it is needless to endeavour to establish any distinction between them in this respect. If the dilatation be general, the form of the heart remains unchanged, but its size is uniformly augmented. If the left ventricle be mainly affected, the heart appears not only enlarged but elongated, the left ventricle taking more than its due share in the formation of the cardiac apex. If the right ventricle be specially implicated, the heart becomes enlarged in its transverse diameter; it is more rounded in its contour as seen from the front than it should be; and its apex is obtuse, and either bifid, from the fact that the apices of both ventricles take an equal share in the formation of the cardiac apex, or formed wholly by the right ventricle. If the auricles be dilated, they constitute large masses on both sides of the root of the aorta and pulmonary artery.

The walls of the dilated heart vary not only in thickness, but also in quality. Thus they may be preternaturally firm or preternaturally soft; they may be healthy in structure, or may present more or less degenerative change.

CONSEQUENCES OF DILATATION.—Dilatation of the ventricles, especially if it be considerable, is apt to disarrange the mechanism of the auriculo-ventricular valves. It was shown many years ago by Mr. Wilkinson King that even in mere temporary distension of the right ventricle a kind of safety-valve action of the tricuspid valve took place, in consequence of which regurgitation of blood was permitted from the ventricle into the auricle. And since his time it has been clearly demonstrated, both by clinical and by *post-mortem* evidence, that established dilatation of the right or left ventricle is liable to be attended with persistent regurgitation of blood through the corresponding auriculo-ventricular orifice. The defaulting valve under these circumstances has a natural aspect; but careful examination shows either that the orifice has undergone dilatation in company with the ventricle—the valve itself presenting no corresponding increase; or that there is a want of relation between the size of the musculi papillares and chordæ tendineæ on the one hand, and the capacity of the ventricle on the other, which interferes with the due closure of the valve.

It is obvious that if regurgitation becomes established, the usual consequences of regurgitation will presently ensue—namely, in connexion with affection of the left side of the heart, dilatation and hypertrophy of the left auricle, and subsequently congestion of the lungs and pulmonary apoplexy; and in connexion with affection of the right side of the heart, dilatation and hypertrophy of the right auricle, fulness of the systemic veins, anasarca, nutmeg liver, and congested, indurated kidneys. It is also obvious that, even if no regurgitant condition be developed, dilatation of heart, which implies feebleness of heart and imperfect circulation, must ultimately induce the ordinary remote consequences of heart-disease. A further consequence of dilatation and other cardiac affections attended with feeble circulation is the formation of thrombi during life, both in the heart itself and in other parts of the vascular system. Mr. Wilkinson King has demonstrated that dilatation of the left auricle may cause compression of the left bronchus.

SYMPTOMS.—Since dilatation of the heart rarely, if ever, exists alone, but is associated with hypertrophy, valve-disease, degenerations, and other conditions, it is almost impossible to make any definite statement with regard to the signs and symptoms by which its presence may be recognised. Still there is no doubt that dilatation is one of the most important factors of heart-disease, clinically considered; and that its supervention materially affects the patient's condition, and prospect of life. Dilatation implies weakness, and as a rule over-distension of the implicated cavities with blood, which probably never becomes wholly expelled.

The *physical signs* of dilatation are necessarily in many respects the same as those of hypertrophy. The præcordial dulness is increased in area—the extent and form of this area, and the situation of the apex-beat, being determined by the general size of the heart, and the relative dimensions of its component parts. In proportion, however, as dilatation preponderates over hypertrophy, the impulse of the heart becomes weak, and possibly to some extent diffused. In extreme dilatation, as in extreme weakness from other causes, the sounds of the heart, and especially the first sound, are enfeebled. And it may be asserted that generally the tendency of dilatation is to shorten the first sound, and to give it the characters of the second sound. It has nevertheless been observed over and over again that it is in the concurrence of hypertrophy and dilatation that the cardiac sounds are apt to attain their greatest intensity. The feebleness of the heart's action is generally attended before long by more or less irregularity; and even in the absence of valve-disease, a mitral or tricuspid systolic murmur, implying regurgitation, is apt to be established.

The symptoms of dilatation are to a large extent those of cardiac obstruction, and more especially of mitral disease. The patient complains of weight, oppression or uneasiness in the cardiac region, with probably a sense of fluttering there, and of a tendency to sighing respiration. He becomes short-breathed, and may have extreme dyspnœa. His face is apt to become livid; his surface pale or ghastly; his extremities cold and blue; and his pulse weak and irregular. Dilatation of the systemic veins arises sooner or later; and subsequently general anasarca, pulsation of the veins in the neck, epigastric pulsation, and pulsation of the liver, together with the other usual consequences of heart-disease. The chief of these are—congestion of the lungs, with pulmonary apoplexy, cough, and expectoration of blood; congestion, enlargement, and tenderness of the liver, with jaundice; and congestion of the kidneys, attended with the discharge of scanty, high-coloured, heavy urine, containing albumen and possibly blood. Other symptoms referable to the nervous and digestive organs, which need not be enumerated here, are also liable to supervene.

The symptoms will vary, of course, according as the left or the right ventricle is mainly affected. In the former case we are liable to have at first irregularity and feebleness of pulse with tendency to faint; then pulmonary complications; and at a later period, symptoms referable to the systemic venous circulation. The latter case is one of considerable interest; because in a large number of instances it is, in its most marked form, a consequence of emphysema of the lungs, or of other analogous conditions, and moreover is apt to come on very rapidly. Under these circumstances, there is necessarily much dyspnœa, but the systemic venous and capillary systems speedily become over-loaded; extreme cyanosis often develops rapidly; and, before long, all the other symptoms referable to disease of the right side of the heart become established: namely, pulsation of the veins in the neck, epigastric pulsation, pulsation of the liver; general anasarca, with perhaps petechial extravasations, jaundice from nutmeg liver, and albuminuria from congestion of the kidneys.

Prognosis.—There is no doubt that some degree of dilatation of the heart, and more especially of the right ventricle, may arise either from over-exertion, or from functional disturbances, and in connexion with pulmonary disorders. But such dilatation is for the most part temporary or remediable; and only by continuance of its cause becomes established and a matter of serious importance. In the same way there is no doubt that the dilatation which comes on in the course of organic disease of the heart or lungs, or of other organic diseases which influence the action of the heart, is remediable within certain limits by due attention to the conditions under which it arises. Nevertheless it is certain that the presence of dilatation of the heart in connexion with other diseases, more especially those of the heart itself, lungs, or kidneys, is a grave source of danger; and that in the great majority of cases it is of fatal omen, aggravating the patient's cardiac symptoms, and hastening his death.

Treatment.—The treatment of dilatation of the heart merges in that of the other cardiac conditions with which it is associated, and in that of other diseases in the course of which it may have supervened. It may be stated, generally, however, that the treatment is that of cardiac debility, and of distension of the heart with blood.

The chief indications, therefore, are rest of mind and body; avoidance of exposure to cold and wet; the exhibition of ample, nutritious, and readily digestible food; due attention to the action of the bowels, kidneys, and skin; and the employment of medicines likely to regulate and strengthen the action of the heart. For the last purpose digitalis in small doses is universally acknowledged to be of great value. And it is in many cases desirable to combine the digitalis with iron, or some vegetable tonic. Ammonia and other diffusible stimulants are often called for, and are of great service. In cases where there is much lividity, and evidence of stagnation of blood in the right side of the heart, removal of blood by venesection will often prove of great service.

When the dilatation is due to pulmonary disease, this of course requires primary and especial treatment. J. S. Bristowe.

HEART, Displacements of.—Besides the displacements of the heart that occur as the result of disease, there are certain changes of position which this organ undergoes in health. The most important of these physiological displacements of the heart are—first, its vertical movements in respiration; and, second, the alterations in its situation corresponding with changes in the bodily posture. The present article, however, will deal only with the former class, or abnormal displacements of the heart.

Ætiology.—The heart may be congenitally displaced—a condition which is described under the head of Heart, Congenital Misplacement of. These cases being excepted, the causes of displacement of the heart may be arranged in two classes—namely, (1) conditions that exert *pressure*, and (2) conditions that exercise *traction*, upon the heart.

1. The heart is *pressed* or pushed out of position by effusions of fluid—inflammatory, serous, or bloody—into either pleural cavity; by pneumothorax of either side; by intrathoracic tumours—whether mediastinal (including aneurysm and abscess), pulmonary, or parietal; by hypertrophous emphysema, or other causes of enlargement of the lungs; by extensive pneumonic consolidation; or by abundant pericardial effusion of any kind. Certain conditions of the abdominal contents

produce a similar effect—for example: gaseous distension of the stomach and intestines; enlargement of the liver and other solid organs; abdominal tumours of all kinds; the pregnant uterus; and ascites, when considerable. Hernia of the abdominal viscera through the diaphragm, and abscesses connected with the diaphragm, also cause displacement of the heart.

2. The heart suffers *traction*, or is drawn out of position, during absorption of pleuritic effusion with imperfect expansion of the lung, on either side; by the contraction of pleuro-pericardial adhesions, of pulmonary cirrhosis, or of cavities in phthisis; in collapse of either lung from pressure on the main bronchus; and in some forms of deformity of the chest from curvature of the spine.

MECHANISM OF DISPLACEMENT.—The causes just enumerated constitute in each instance what may be called the *displacing force*. When this force belongs to the first or *pressure* class, it acts against the surface of the pericardium and heart that is opposed to it, and presses or pushes it, *a tergo*, away from its own seat, in the direction of least resistance. Thus the heart is, speaking broadly, pushed towards the left by effusion into the right pleural cavity; towards the right by similar disease on the left side; downwards by tumours in the region of the base; and upwards by gaseous distension of the stomach.

On the other hand, when the displacing force is of the nature of *traction*, the heart is drawn *a fronte*, that is, towards the seat of the force. Thus, when a cavity in a phthisical lung is contracting, the pericardium and heart, as well as the walls of the chest, are displaced towards the healing area. It must be observed, however, that in this class of cases, actual traction, in the strict sense, is rare, and that the ordinary displacing force is, in reality, the atmospheric pressure; the heart and the other organs being 'sucked' towards the potential vacuum, in the same way as water is 'drawn' into a syringe. Still, in a very small number of cases, the pericardium does actually become involved in a healing process in the lungs; and it and the heart are dragged towards the cicatrix.

Besides the displacing force, there are at work in dislocation of the heart certain other agencies, which contribute to the result, whether their effect be to increase or to diminish that of the chief cause:—

(*a*) The weight of the heart manifestly favours displacement in different directions, according to the posture. Thus, in the erect posture, it favours downward, and limits upward displacement. However, the effect of the weight of the heart is comparatively insignificant, and may be practically disregarded.

(*b*) The resistance, positive or negative, of neighbouring parts must be taken into account. The heart when disturbed from its position will move in the direction of least resistance. Thus it cannot be displaced to any extent either forwards or backwards; but is moved with comparative ease towards either pleural cavity. The resistance inferiorly is greater under the right half of the diaphragm than under the left. On the other hand, the resistance around may become negative; for example, in left pleural effusion the corresponding half of the diaphragm is pushed downwards, and the accompanying downward displacement of the cardiac apex is thus increased.

(*c*) The heart is attached at its root; and, speaking broadly, this is a fixed point, at the right and upper extremity of the long cardiac axis. This attachment will limit and otherwise modify displacements of the heart in all directions, especially downwards. Round this point as a centre, and with the long axis as the radius, the apex of the heart would describe an arc of a circle, cutting the surface of the chest in the left axilla, the left submammary region, the epigastrium, the right submammary region, and the right axilla.

(*d*) The tendency that the heart has to rotate or roll on one or other of its axes is also affected by its attachment at the root. If the heart lay free in the pericardial cavity, there would be no limit to such rotation under the influence of pressure or of traction. The base being fixed, rotation is greatly limited, and does not occur to any extent except around the longitudinal axis; the left ventricle, for example, being rotated more forwards or more backwards, as the case may be. Rotation round the transverse-horizontal and the antero-posterior-horizontal axes is very limited.

ANATOMICAL CHARACTERS AND EFFECTS.—The only essential change that the heart is found to have undergone in displacement is an alteration of its relations to the surrounding parts. The softer parts of the cardiac wall, however, such as the auricles, are sometimes compressed to a moderate degree. The pericardium is partly dislocated and partly stretched. The great vessels at the base of the heart and at the root of the neck may be elongated, shortened, twisted, or bent, according to the particular form of displacement; and the circulation within them impeded. The neighbouring organs are variously displaced and compressed. One of the effects often seen after displacement is permanent fixation of the pericardium and heart in their new position, for example, in the pleural cavity, on the disappearance of the original cause.

The effects of displacement of the heart upon its functions differ greatly in the two classes of dislocation to which we have referred:—

In displacement due to *pressure*, the heart is compressed between the displacing force and the resistance in other directions, and the dislocation is generally rapid. Fortunately, in most cases of such displacement the resistance is slight; and the heart, if healthy, suffers little or no real compression of its substance or cavities between the two forces, the mobile and compressible lung especially yielding before it. But if the heart be diseased—and especially if its walls be weak, degenerated, or dilated—moderate compression, as in flatulence, may cause embarrassment of the cardiac action and even fatal paralysis; and the rapidity or even suddenness with which displacement generally occurs when due to pressure—for example, in pneumothorax—is another and perhaps the principal cause of this embarrassment.

On the other hand, when the heart is *drawn* out of its normal situation towards a phthisical cavity, or towards either pleural cavity from which an inflammatory effusion is being absorbed, the displacement occurs, not because there is want of space, but because there is excess of space within the thorax. The process is also very gradual. The effects, therefore, upon the functional activity of the heart may be said to be few, though the unusual pulsation may be a source of inconvenience, and even of anxiety, to the patient. In very rare cases, the heart and pericardium, when thus displaced, may be involved in the fibrotic process going on in the lung or pleura, and the adhesions thus established may ultimately interfere with the cardiac action.

SYMPTOMS.—In displacement of the heart, special symptoms are frequently slight or altogether wanting; or they are inseparable from the symptoms of the original cause. This may be said to be almost invariably the case when the displacement is due to gradual traction, as in phthisis. In the pressure class of cases, on the contrary, there are frequently developed, and that rapidly or suddenly, symptoms due to compression of the heart, such as a sense of distress, stifling, and pain over the præcordia or at the epigastrium, or even true angina; dyspnœa, perhaps amounting to orthopnœa; palpitation; blueness of the surface; and irregularity and feebleness of the pulse. When the displacement is due to upward pressure from gaseous distension of the stomach and intestines, the above symptoms may be associated with flatulence or 'spasms,' and are relieved by the erect posture, eructation, vomiting, and the administration of carminative and absorbent remedies. If this condition be not removed within a short time, it may become aggravated, pass into a state of collapse, and end in death.

VARIETIES AND PHYSICAL SIGNS. — The varieties of cardiac displacement, according to the direction in which the dislocation occurs, may, for clinical purposes, be said to be as follows: towards the *left*, towards the *right*, *downwards*, *upwards*, *backwards*, and *forwards*. It must be observed, however, that this is only a broad general classification, and that the heart is very rarely displaced in an absolutely horizontal, or in an absolutely vertical plane. The exact direction taken in each variety will now be described, as well as its special causes, and the physical signs by which it may be recognised.

1. **Displacement towards the Left.**—This, the most common variety of marked cardiac dislocation, is most frequently caused by contraction of the left lung from any of the conditions already enumerated, and effusions into the right pleural cavity. Right pneumothorax, and tumours connected with the right side of the chest, with the mediastinum, or with the right lobe of the liver, are less common conditions leading to the same result. The distance towards the left to which the heart is dislocated varies, the extreme limit being probably the vertical axillary line. During its progress towards the left, the heart is rotated around its longitudinal axis, so that the right ventricle is more exposed anteriorly; and the apex is moved, at first somewhat downwards, and afterwards upwards.

The visible and palpable impulse is found to the left of its normal situation, and either lower or higher than it, or on the same level with it, according to the degree of displacement. In some cases due to contraction of the left lung, the impulse may be found in any one or in all of the left intercostal spaces from the base to the apex of the heart, and of different rhythm in the different spaces. If the displaced heart be the seat of valvular disease, thrill may be felt in an unusual situation, for example, in the left axilla. The area of percussion-dulness is altered in outline, being invaded on the right side either by the dulness due to effusion there, or by resonance due to pneumothorax or to encroachment of the right lung-border; whilst it is either transposed towards the left axilla, or blended with unnatural dulness over the left lung. The cardiac sounds are reduced in loudness over the normal præcordia, whilst they are unnaturally loud towards the left axilla and up the left front. Structural murmurs if present are similarly transposed, as regards the seat of their greatest intensity and the lines of their convexion. A systolic murmur may be developed at the base of the heart from distortion of the great vessels.

2. **Displacement towards the Right.** This form of dislocation of the heart is the result of effusion into the left pleural cavity; of contracting processes connected with the right lung or pleura; of left pneumothorax; and of tumours of the left side of the chest or in the mediastinum. The heart may be displaced towards the right side until the impulse is found in the axillary region, the true apex at the same time being depressed

towards the epigastrium. During its lateral movement, the heart is rotated on its longitudinal axis in such a manner that the left ventricle is more exposed.

The physical signs correspond closely with those enumerated under left displacement—the two sides being, of course, exactly reversed. The cardiac impulse is most frequently transferred to the epigastrium. New areas of pulsation are developed in the region of the right nipple, and in the second and third right interspaces, close to the sternum; they indicate the displaced position of the right auricle, if præsystolic, or of the aorta, if systolic and followed by palpable shock in diastole. The description of the auscultatory phenomena, as regards both sounds and murmurs, does not require to be repeated.

3. **Displacement Downwards.**—This is an exceedingly common form of cardiac displacement, though seldom extreme in degree. It is the constant result of hypertrophous emphysema of the lungs; and may also be caused by the downward pressure of tumours at the base of the heart, such as aneurysm, and by collapse of the stomach and intestines. Displacement of the heart downwards is limited by the diaphragm, and by the attachment of the pericardium and great vessels at the root of the heart. At the same time the apex may either move somewhat towards the left in its descent if the downward pressure be uniform, as in emphysema; or it may ascend somewhat towards the left if the pressure be exerted chiefly upon the base.

The ordinary cardiac impulse is generally quite imperceptible in this form of displacement, on account of enlargement of the lungs; or it is greatly weakened, and situated in the sixth left space, or lower, to the left of its normal position. A new area of systolic pulsation is perceptible in the epigastrium, generally well marked, and connected with the right ventricle. The præcordial dulness is usually completely replaced by pulmonary resonance; or, more rarely, confused by the dulness of some form of mediastinal tumour. The cardiac sounds are feeble, or absent, over their usual seat; and are heard, instead, over the epigastric triangle and the lower left cartilages.

4. **Displacement Upwards.**—The many abdominal causes of this form have been already mentioned; so have the symptoms due to compression of the heart which characterise it when so produced. The heart, as a whole, is moved upwards in the chest, and at the same time the apex passes more or less towards the left, and the right ventricle may become somewhat more exposed anteriorly.

The cardiac impulse is elevated until it is found on the nipple-level, or even higher; or it is lost, along with the area of percussion-dulness, behind the inferior border of the left lung. The sounds of the heart are transposed upwards, and weakened. The displacement of the cardiac apex towards the left axilla in pericardial effusion is described elsewhere. *See* PERICARDIUM, Diseases of.

5. **Displacement Backwards.**—This variety of displacement of the heart is very uncommon; and when it does occur, is generally referable either to abundant pericardial effusion, or to backward curvature of the spine (kyphosis) in the dorsal region. A certain amount of backward displacement is, however, not so rare in extensive excavation of the left lung, in association with other forms of dislocation. The base of the heart is then the part most transposed into the left paraspinal groove, and the apex is tilted somewhat forwards as well as elevated.

The physical signs of backward displacement are those of the cause of the malposition rather than any that can be referred to the condition itself.

6. **Displacement Forwards.**—Displacement forwards is also very rare, although it is frequently simulated by bulging of the præcordia in enlargement of the heart. The chief cause of it is the presence of a tumour in the mediastinum—especially aneurysm of the descending aorta, or enlargement of the bronchial glands. The amount of actual transposition is necessarily exceedingly small, the anterior border of the lungs being compressed or pushed aside, but the further progress of the heart forwards being arrested by the anterior wall of the chest.

The physical signs are, therefore—increase of the area and strength of pulsation and of percussion-dulness over the præcordia; bulging of the same in young subjects; and increased loudness of the cardiac sounds in that situation.

7. **Complex Displacements.**—It has already been indicated that displacements of the heart, strictly speaking, occur almost without exception in more than one of the directions described; and they may all, therefore, be said to be generally more or less complex. Dislocation at once upwards and towards either side is especially common, as the result of contracting processes in the apex of the lung.

DIAGNOSIS.—After the full account that has been given of the several forms of displacement of the heart, there ought to be no great difficulty in diagnosing them from each other, as well as from the conditions which simulate them. These must be carefully remembered. The chief of them are: (1) Physiological displacements, already referred to; (2) cardiac enlargement, especially when attended with bulging of the præcordia; (3) pulsating tumours of the chest and abdomen, particularly aneurysm of the aorta; (4) adhesion of the pericardium; and (5) atrophy of the lungs from any cause.

TREATMENT.—The rational treatment of

displacement of the heart would be to remove its cause; but when the cause is of the nature of traction, treatment is very rarely called for, even if it were possible. In displacement due to pressure, on the contrary, treatment is often urgently indicated, perfectly practicable, and highly successful. The unpleasant sensation of pulsation complained of in some instances of displacement—for example, in phthisis—is frequently relieved by an assurance on the part of the physician that the palpitation is of no import; and by the application of a simple plaster, containing iron, belladonna, or opium.

J. MITCHELL BRUCE.

HEART, Embolism of.—*See* EMBOLISM; and HEART, Thrombosis of.

HEART, Fatty Degeneration of.—SYNON.: Fr. *Dégénérescence graisseuse du Cœur*; Ger. *Fettige Metamorphose des Herzens.*

DEFINITION.—The process by which the muscular fibres of the heart are converted into a granular fatty matter. The term is also used to express the state of the heart in which this change has been accomplished.

ÆTIOLOGY AND PATHOLOGY.—The process by which the protein elements of animal bodies, including muscular fibre, are converted into granular fatty matter, as well as the circumstances under which this change occurs, have been already so fully discussed under the head of FATTY DEGENERATION, that it is unnecessary to repeat the information which will be found there. It will suffice to say here, that when the process of nutrition is interfered with in the tissue of the heart, this change takes place, and is best illustrated in the *local* or *limited* form of disease, which occurs when the coronary circulation is obstructed. This is seen in cases in which the orifice of the coronary arteries is contracted or where there is thickening or calcification of one of the trunks, or of the branches of these vessels, and is more marked by reason of the fact that the coronary arteries do not anastomose as freely by their primary and secondary branches as do arteries in other situations. Still, as Dr. Samuel West has well shown (*Lancet*, vol. i. 1883), there does exist free communication. The fatty change is found to occur in the more *diffused* or *general* form in those diseases in which the vital powers are lowered, as in certain forms of chronic cachectic disease, especially in cases of pernicious anæmia, as described by Dr. Sidney Coupland (*Brit. Med. Journ.*, vol. i. 1881), in poisoning by phosphorus, or after loss of blood. In certain other conditions, such as acute specific fevers, the tissue of the heart becomes softened, and under the microscope presents a granular appearance, which is believed by some pathologists to be an incipient stage of fatty degeneration. We might also refer to the more or less diffused form of fatty degeneration which takes place in cases of enlarged heart, the result, not, as Rokitansky supposed, of a disturbance of the nervous functions, but of the fact that these enlarged hearts require a larger supply of the materials for nutrition than can be furnished to them by the coronary arteries, which in such cases are frequently themselves diseased, both at their origin and in their course. Lastly, fatty degeneration of the heart is found to occur after delivery in some instances, in which the organ had become enlarged during pregnancy, thus explaining certain cases of sudden death after parturition. Dr. Bedford Fenwick has described (*Lancet*, vol. i. 1888) fatty degeneration occurring in consequence of the pressure exercised by the presence of large ovarian tumours; and he accounts for the collapse which sometimes occurs after operation for the removal of these tumours by the presence of this lesion of the heart's texture.[1]

Certain other circumstances connected with the origin of the disease require to be mentioned here. In reference to *sex*, the disease is more frequent in males, in the proportion of nearly two to one. With respect to *age*, in his original memoir on this subject the writer found that nearly one-half of all the cases observed were over sixty years of age. In the late Dr. Hayden's valuable work on *Diseases of the Heart*, the proportion stated of cases under sixty years of age shows a larger number of young persons whose hearts have undergone this change as a result of wasting disease—a result which is evidently due to the greater care with which microscopical examinations of the heart have been made in recent times. As regards *social position*, of thirty-three cases formerly noted by the writer, the subjects of the disease are stated to have belonged to the higher ranks in nine cases; to the middle class in eight cases; and to the lower class in sixteen cases. This enumeration contrasts with the proportion in which fatty growth appears on the heart; seven of fifteen cases belonging to the first class; six to the second; and only two to the third. Fatty degeneration and fatty growth on the heart are thus seen to occur under markedly different conditions. The latter is the result of the accumulation in the blood of the elements of fat; the former is the result of decay and disintegration of tissues.

ANATOMICAL CHARACTERS.—In fatty degeneration the heart was found to be enlarged in about two-thirds of the cases recorded both by Dr. Hayden and the present writer. It is not infrequently simply dilated. To find a heart thus affected of an average size, or even occasionally below it, is not an exceptional occurrence. The colour of the heart's substance is pale, sometimes as pale as 'a dead leaf,' but more generally it is of a yellowish-brown or buff, or muddy pink colour. This discoloration is generally seen in spots or in patches; and though the whole heart may be pale, the spots, being still paler when seen beneath the endocardium, give the tissue a mottled look. The same appearance may be observed beneath the pericardium, and in the substance of the heart. With the progress of disease the spots run together, giving portions of the walls a uniform buff-coloured character, whilst the rest of the organ retains its ordinary aspect. The consistence also varies from that of mere flabbiness or softness, to such a condition as permits of the tissue being torn like wet brown paper. The organ then feels like a piece of wet chamois leather, or a wet glove. In other cases the heart retains in appearance much of its ordinary solidity, but the tissue breaks down on pressure, as does a lung consolidated by pneumonia. This is a state which occurs more frequently in hearts which are hypertrophied. In addition to these changes in size, colour, and consistence, others have to be noted. The fibrous character of the heart's structure, even to the naked eye, disappears; in some cases the tissue resembles that of a fatty or a boiled liver. In other instances the cut or torn surface has a granular appearance, not unlike that of the lung in an early stage of grey hepatisation. These different appearances may in a great measure be due to the greater or less fluidity of the oily matter present, as well as to the extent and degree to which the disease has advanced. Further varieties in appearance may be caused by the presence of a larger or smaller quantity of blood, or of its colouring matter, in the heart's texture or in its cavities, by which the lining membrane may in the latter case be dyed of a deep purple colour.

---

[1] For much very instructive and valuable information, see an article, by Dr. F. W. Mott, on 'Cardio-Vascular Nutrition and its Relation to Sudden Death,' in the *Practitioner*, vol. xli. p. 161.

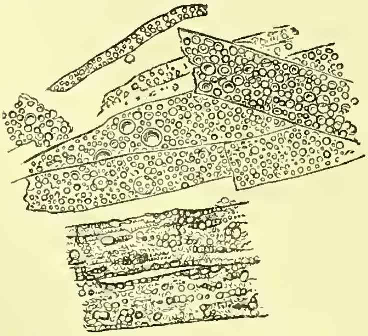

Fig. 60.—Fatty Degeneration of the Heart. × 400 diam.

Microscopical characters.—The microscopical characters of this disease will be found so fully described under the head Fatty Degeneration, that it is needless here to do more than refer the reader to that article, and to the annexed figure (60), in which these characters are well seen.

All parts of the heart are subject to fatty degeneration, but not equally so. It is most frequently found in the left ventricle; next in the right ventricle; then in the right auricle; and least frequently in the left auricle. It is generally more evident in the columnæ carneæ, and in the inner layers of the muscular walls, than elsewhere.

Effects.—Of the *structural* lesions which occur in the heart when it is the seat of fatty change, one of the most important is *rupture*, which was found in twenty-five out of sixty-eight cases of fatty or softened heart, the histories of which were collected by the writer. Partial rupture, leading to some effusion of blood in the tissue and the formation of what has been called *cardiac apoplexy*, is another condition which has been described. The clot in such cases, if it lose its colour, may produce the appearance of an encysted abscess; and a consecutive false aneurysm of the walls of the heart may be thus formed, as well as by the simple yielding of a portion of the softened cardiac wall. The involvement of the columnæ carneæ may lead to imperfect action of the valves. Valvular disease itself is not often present in connexion with fatty heart. Dr. Henry Kennedy, in a late interesting work on this subject, pointed out that the valves are affected only about once in nine cases; and he further shows that, when the valves are affected, it is chiefly the aortic valves that are involved.

Of the effects of fatty degeneration upon the *functions* of the heart, the most prominent are those which exhibit the weakened powers of the organ. *Coma*, preceded or not by giddiness, has been described by several writers in connexion with feeble powers of the circulation. The late Dr. Adams of Dublin has mentioned as many as twenty attacks in one of his cases of fat heart; and the writer has noticed the occurrence of even more frequent seizures. *Syncope*—'cardiac syncope'—is a term very frequently used by the older writers; and it is a term which may be well applied to the condition of faintness which is frequently found in connexion with fatty heart. In some cases the feeling of syncope amounts to little more than a simple sense of faintness—that the patient must fall if he do not lay hold of something. In other instances this symptom is accompanied by a feeling of impending death; and such patients do frequently die. In the cases collected by the writer, thirteen out of thirty-three died of what he proposed to call *syncope lethalis*, or 'fatal syncope;' and it would be possible, no doubt, now greatly to extend the number of cases that have proved fatal in this way. Death may result in such cases from cardiac failure, as indicated after death by a flabby heart containing blood in the left ventricle; or, where there is a less amount of degeneration, death may result from irregular action or spasm, and the ventricles may be found empty.

Pain is also an effect of degeneration. It may occur independently of syncope; or, being associated with syncope, constitutes what is named *syncope anginosa*. *See* ANGINA PECTORIS.

The *respiration* is always affected in cases of fatty degeneration, and we find either simple breathlessness, even on slight exertion, or that peculiar form which has been called *Cheyne-Stokes respiration*.

SYMPTOMS AND DIAGNOSIS.—There is no doubt that many cases occur in which fatty degeneration is found in the heart after death, without its presence during life having been suspected. This result is found more especially in those instances of exhausting disease in which the heart participates. In such cases the requirements of the system may not be out of proportion to the powers of the heart; and death may come on slowly and insidiously without our attention being attracted to the state of this organ. In a second class of cases, in which the heart suffers from some local cause, as, for example, from disease of the coronary arteries, whilst the system generally maintains its powers more or less fully, the balance between the system and the function of the heart is lost, and diagnostic evidence of the change that has occurred in the central organ, sufficiently clear and pointed, may be traced without difficulty. Amongst the symptoms of the disease we then observe various modifications of the phenomena of drowsiness and coma; faintness and syncope; disordered respiration; pain in the region of the heart; and disturbed pulsation. For example, the patient complains in the earlier stages of being easily exhausted, particularly by mounting ascents; he feels, he says, faint on reaching the top of a flight of stairs; though not giddy, he feels he must fall; though not breathless or fainting, he sighs deeply and seeks the air. Any unusual excitement, or a heated or a close atmosphere, produces the like effects. At the same time there is often experienced an uncomfortable feeling of choking or fulness in the chest. In the intervals the individual may be fairly well.

As the disease advances, the attacks, of whatever kind, become more frequent and severe, and often disturb and distress the patient at night. The temper is observed to become irritable. The expression of the features frequently appears anxious, and the countenance sallow. Copious perspiration from very slight causes, sometimes coldness of the extremities and swelling of the ankles, appear amongst the incidents of the disease. The pulse is generally affected; but how must no doubt depend in a great measure upon the part of the heart affected, and on the extent and degree of the disease. In the writer's opinion, intermittence and irregularity are the more frequent alterations; weakness is another; and slowness—often remarkable—is a third. Quickness of the pulse, more especially when it increases with age, has been dwelt upon by Dr. Kennedy as a symptom deserving of attention in the diagnosis of fatty degeneration. The irregularity may be constant, or it may appear and disappear. The writer has seen it present during the slight disturbances above described; and he has seen it disappear altogether when the patient was in tolerable health, to return as the effect of any depressing cause, the more marked because that cause may be far too inefficient to affect a sound heart. The frequency with which the pulse is affected in cases of dyspepsia, more especially in those in which there exists a gouty diathesis, should not be overlooked in the diagnosis of fatty heart.

The breathing is always more or less affected in cases of fatty degeneration of the heart. In some instances the disturbance is represented as a sense of choking or suffocation; the person feels as if he were breathing through a sponge. The difficulty in some instances is so slight as scarcely to be regarded; in others so severe that the smallest effort, particularly in mounting ascents, is most painful. A peculiarity sometimes observed is that the ascent of a gentle height is distressing, while the person can read aloud without inconvenience. A character of the respiration first described by Dr. Cheyne of Dublin, and afterwards by Dr. Stokes, is by some regarded as diagnostic of fatty degeneration of the heart. It is thus described by Dr. Stokes: 'A form of respiratory distress peculiar to this affection (fatty degeneration of the heart), consisting of a period of apparently perfect apnœa, succeeded by feeble and short inspirations, which gradually increase in strength and depth until the respiratory act is carried to the highest pitch of which it seems capable, when the respirations, pursuing a descending scale, regularly diminish until the commencement of another apnœal period.' Dr. Hayden, in writing on this subject, mentions a case in which during the period of apnœa there was no change in the heart's action; a second case in which the action of the heart and the pulse underwent no change during the period of apnœa and dyspnœa; whilst in a third case, during the paroxysm of dyspnœa, the heart's action was remarkably irregular. It should be stated with regard to this symptom that, though frequently present, it is by no means characteristic of fatty degeneration only. It is by some said to be more frequently associated with disease of the aorta. Various explanations of this phenomenon have been given. Dr. Little (*Dublin Journ.*

of Med. Sci., No. 91) believes that it is due to derangement of the dynamic adjustment between the right and left ventricles of the heart. Dr. Hayden (*op. cit.*) connects it with atheromatous or calcareous change with dilatation of the arch of the aorta, involving loss of elasticity in its walls. The late Professor Laycock thought (*Dublin Journ. of Med. Sci.*, July 1873) that this phenomenon depended upon 'sentient palsy of the respiratory centre,' or 'a paresis of reflex sensibility of the mucous membrane of the lung.' This respiratory action, though suggestive of some grave and serious source, may pass away. *See* RESPIRATION, Disorders of.

Another phenomenon, said to be diagnostic of fatty degeneration of the heart, is arcus senilis—a pearly crescentic opacity of the upper and lower portions of the circumference of the cornea, which must be distinguished from an opaque annulus which occasionally surrounds the entire cornea, and which is not the result of fatty degeneration. The late Mr. Canton was the first to describe the nature of this change as fatty degeneration. It is quite true that when fatty degeneration is present in the cornea it may possibly be found in the muscular fibres of the heart and in the arteries. Still it by no means follows that the degeneration must exist in any other particular part or organ, and therefore this appearance in the cornea cannot be at all regarded as pathognomonic of fatty degeneration of the heart.

As the disease progresses the symptoms become more marked; the various effects of feeble and languid circulation further show themselves; angina may perhaps become fully developed; or the patient may be cut off suddenly by one or other of the effects connected either immediately or remotely with the lesion itself. Of eighty-three cases of 'fatty disease' of the heart collected by the writer, sixty-eight had died suddenly.

PHYSICAL SIGNS.—The physical signs that characterise fatty disease are neither many nor marked. They are—a feeble impulse of the heart, proportionate to the extent and the degree of the disease; a feeble muffled first sound, under like conditions, sometimes scarcely audible. When the heart is enlarged, the impulse, though weak, will be found extended, and so likewise will be the dulness on percussion. A murmur may be present, as suggested by Rokitansky, from degeneration of the columnæ carneæ. The second sound is often distinct and clearly accentuated, as compared with the first.

DIAGNOSIS.—The diagnosis of the presence of this degenerative change, in the absence of any alteration in the size of the heart, must be founded upon a consideration of the symptoms and physical signs above described. When the heart is hypertrophied or dilated only, the presence of fatty degeneration is more difficult of diagnosis by its physical signs. We must then seek to trace how far the usually well-marked signs of hypertrophy of the organ are modified by those we have described as being present in, and characteristic of, fatty degeneration. The same observations will apply to dilatation or thinning of the walls. This special condition has its own well-marked phenomena, which will be found described elsewhere (*see* HEART, Dilatation of). These signs will be more or less modified in proportion to the degree and extent of any fatty change that may be present. They must be carefully studied so that they be not confused with like conditions originating in disordered state of other organs, as the lungs, the liver, &c.

PROGRESS, DURATION, AND TERMINATIONS.—It is impossible to determine the duration of a disease the date of origin of which is in most cases very obscure. Still there are grounds for believing that persons with a certain amount of degenerated tissues in their hearts have gone on living during periods extending over many years. On the other hand, death has occurred from fatty degeneration of the heart, determined *post mortem*, in which the entire absence of symptoms until a few months before the fatal event justified the opinion that the duration of the disease had not much exceeded the period just mentioned. When fatty degeneration occurs as the result of phosphorus-poisoning, or of certain exhausting diseases, the progress of the change, which can then be determined, is rapid. In such cases, the morbid process is not confined to the heart alone, and therefore when death occurs, it cannot well be attributed solely to the condition of this organ.

Death is frequently sudden, the proportion being as five to one compared with other modes of death from fatty disease of the heart. The immediate modes of death in these cases are those which have been already alluded to when treating of the *effects* of the disease, namely, by syncope, angina, coma, and rupture of the heart; the first and last of these contributing nearly the whole number of those who die suddenly. Such facts indicate very strongly the necessity of avoiding any mental excitement or physical exertion which might lead to these results. Here it might also be well to remember, with reference to the administration of anæsthetics, that chloroform has an especially depressing effect on the heart's action; and that when the heart's power is enfeebled by the disease which we are here describing, a very small dose of this anæsthetic, which would have little or no effect on a healthy heart, may prove fatal. This opinion was first expressed by the writer many years ago, in 1850, and it has been fully confirmed by numerous cases of death which have since occurred during the administration of chloroform.

PROGNOSIS AND TREATMENT.—The prognosis of fatty degeneration of the heart must depend in a great measure upon a knowledge of its cause and its extent. In cases where the disease originates in constitutional causes, such as in phosphorus-poisoning, and in cases where it is of the nature of involution—for example, after parturition—there is good ground for believing that, the cause being removed, the effect will cease, and a fairly healthy condition of the organ be restored. On the other hand, when the coronary arteries are obstructed, and degeneration is thereby set up, or when nutrition generally is impaired, and all the tissues are more or less undergoing this change, the prognosis must be in the highest degree unfavourable, more especially so if in the latter case the patient cannot be placed in a condition by which this degenerative tendency may be counteracted.

The treatment consists in the adoption of all the measures calculated to improve the general health—such as pure fresh air, wholesome food, and temperance, together with moderate exercise (either carriage, riding, or walking), if it can be accomplished without causing pain or breathlessness. Everything which may tend to lay stress on the heart's action, such as walking uphill or making efforts, or any mental excitement, should be avoided. With reference to drugs, such tonics as can be best tolerated by the patient might be given. We may mention iron—especially dialysed iron—phosphorus in small doses, and strychnine. Special attention must be paid to the condition of the excretory organs, such as the kidneys and liver, which are liable to become congested when the cardiac action is feeble. Lastly, it may be said that in cases of syncope, in addition to the administration of the usual stimulants, galvanism applied from the back of the neck to the præcordia by the interrupted current, has in a few instances been known by the writer to be useful.

For further information on the subject of Fatty Degeneration of the Heart the reader may consult the complete and very valuable article by the late Dr. Hayden in his work on *Diseases of the Heart*; and a memoir by the writer in the 33rd vol. of the *Med.-Chir. Trans.* (1850). RICHARD QUAIN.

HEART, Fatty Growth on.—SYNON.: Fr. *Hypertrophie graisseuse du Cœur*; Ger. *Fettige Infiltration des Herzens.*

DEFINITION.—The growth of fat on the surface and in the substance of the heart, in quantity sufficient to interfere with its functions, and thus to constitute a disease.

ÆTIOLOGY.—In our inquiries concerning the cause of this condition, we are met with the problem, still to be solved, Why are certain individuals, and certain parts of the body, more prone to the formation of fat than other persons and other parts? We can ascertain with some degree of certainty the circumstances which promote the formation of fat in general; and observations collected by the writer and others show that when fat is thus formed throughout the system, the heart is likely to partake largely of the accumulation. We may accordingly refer to the article OBESITY, in which the causes of fatty growth in general will be found discussed.

Of fifteen cases of extreme fatty growth on the heart collected by the writer, eleven occurred in very fat individuals, and only one in a person who was described as being 'thin.' Age seems to exert a decided influence upon the formation of fat upon the heart. It is very scanty in infancy, and is rarely present in any quantity before the thirtieth year. Corvisart, however, quotes from Kercking the case of a child whose heart seemed wanting, so great was the quantity of fat in which it was embedded. Of the fifteen cases just referred to, thirteen were above fifty years, and one only under that age. Males, according to the same data, are more liable to accumulation of fat on the heart than females, the respective numbers being as twelve to three.

ANATOMICAL AND PATHOLOGICAL CHARACTERS.—A certain amount of fat-tissue, which is not inconsistent with health, occupies a definite position in the structure of the heart. It is seen most abundantly in the groove between the auricles and the ventricles; and as the distribution of this tissue bears a relation here, as in other parts, to that of the blood-vessels, it first appears in the course of the primary branches of the coronary arteries; then in the course of the secondary branches—that is, in the groove over the septum, which marks the boundary between the ventricles; and, lastly, it follows the distribution of the small lateral branches. These branches are more superficial over the right ventricle than over the left; hence the former is found always and more abundantly covered with fat. A fringe of fat is also found at the apex of the heart; and frequently around the margins of the auricles. A mass of superabundant fat will of itself be sufficient to press on and embarrass the action of the heart; but fat rarely exists in this abundance on the surface of the organ without insinuating itself between, and encroaching on, the muscular fibres. In this way the muscular portions of the walls of the organ become thinner and thinner, until the columnæ carneæ may appear to arise from a mass of fat. This state constitutes what was once regarded as fatty degeneration of the heart, and which has also been called 'fatty metamorphosis;' but it is in many cases nothing more in reality than a simple hypertrophy of fat. In parts of hearts which are less affected, that is, where fat is not very abundant, simple striæ of yellow tissue will be observed lying amongst the muscular fibres—an appearance often found in the auricles.

Microscopical appearances.—When a portion of heart suffering from fatty growth in a high degree is examined with the microscope, it will be found that where the growth is most advanced, that is, towards the external surface, very few muscular fibres can be seen, and that the very wide intervals between them are occupied by fat-cells (see fig. 61). Proceeding inwards, the muscular fibres become more evident; the fat-cells become fewer; and, finally, we reach the muscular fibres beneath the endocardium, with a few fat-cells lying here and there amongst them. It is worthy of note that the fibres, though overwhelmed by fat, may still retain their organisation. In all cases, however, the course and direction of the fibres are more or less modified and distorted. The fact that the fibres still exist, though concealed, affords an explanation of the persistence of the heart's action in those instances in which the muscular walls appear to a greater or less extent replaced by fat. It might also be mentioned that small masses of fatty tissue sometimes appear beneath the endocardium, varying in size from that of a pin's head to that of a pea. The writer has seen these little fatty tumours in cases where there was a considerable, but not an excessive, amount of fat upon the surface of the heart.

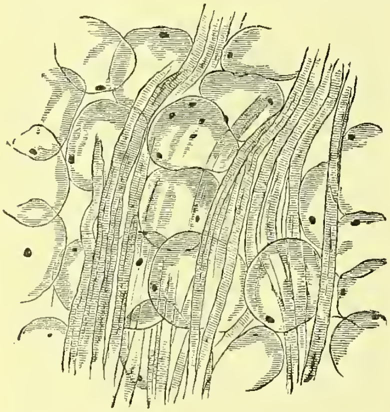

Fig. 61.—Fatty Growth in the substance of the Heart. × 400 diam.

Effects.—The fat accumulated on the heart and in its substance may be supposed to act mechanically; and by its pressure upon the muscular fibres, on the nerves, and on the blood-vessels, to impede the function of the organ, embarrass its nutrition, and produce those effects which may be briefly enumerated as—a languid and feeble condition of the circulation, with a sense of uneasiness and oppression in the chest; embarrassment and distress in breathing, drowsiness, even coma; syncope; perhaps angina pectoris; it may be death. Rupture of the heart sometimes results. Such an enumeration of evils, in which there is no evidence of any other lesion of the heart's texture, save an accumulation of fat, would suffice to render this condition a source of very grave import; but we cannot always be quite clear on the subject, because in the particular cases quoted it is possible that some degeneration of the muscular fibres may co-exist. It would be well, therefore, not to dwell too much on such effects as proceeding from and dependent on fatty growth alone.

Diagnosis.—The presence of an excessive deposit of fat about the heart must, in a great measure, be a matter of inference during life. Where one or more of the effects mentioned above as having been noticed in cases of this kind are present; when the pulse is small and weak; when the first sound of the heart is feeble, and the impulse weak; when the extent of dulness on percussion is increased; and when these phenomena occur in a fat person, it may be inferred that the heart is too fat.[1] But, on the other hand, it must not be overlooked that these symptoms and signs may be found in cases of fatty degeneration of the walls of the heart, in cases where the amount of fat-tissue is but moderate. Nay, more, as already stated, both conditions are often present in the same heart, thus rendering distinctive diagnosis impossible. It is said that the presence of water in the pericardium may be confounded with the presence of fat upon the heart; but the history and general features of the case in the former condition should be sufficient to prevent all difficulty in the diagnosis. *See* Pericardium, Diseases of.

Treatment.—The treatment of fatty accumulation on the heart is so intimately associated with the subject of the formation of fat in general, that this point can be discussed with more advantage in its wider relations (*see* Obesity). Whilst the treatment directed to this point is being carried out, we can do little more for the heart itself than aim at giving strength to the portion of its texture still available for duty—by tonics, steel, quinine, phosphorus, &c.; secondly, by lightening as far as possible the work which the heart has to do; and thirdly, by attending to the excreting organs, so as to prevent congestion there, and consequently embarrassment to the weak heart.

---

[1] Dr. Henry Kennedy, of Dublin, in a lately published special monograph on *Fatty Heart*, states that the points upon which the diagnosis of fatty growth on the heart mainly turn are the following: 'First, a large full pulse, beating at the natural standard of frequency; secondly, evidence derived from percussion of the heart's dulness being more extended than natural; thirdly, the possible presence of a soft systolic murmur over the aortic orifice, occupying the first sound of the heart only, and leaving the second normal; and, lastly, the condition of the individual as to his being fat or otherwise' (p. 39). The present writer hesitates to agree with Dr. Kennedy as to the condition of the pulse generally, and certainly this description will not apply in the cases of those persons of small frame, with small arteries, who often become obese and present symptoms of fat-heart after the middle period of life.

RICHARD QUAIN.

HEART, Fibroid Disease of.—SYNON.: Chronic Myocarditis.

DEFINITION.—A morbid condition in which the muscular fibres of a portion of the walls of the heart are replaced by fibroid tissue.

ÆTIOLOGY.—Fibroid disease of the heart is met with most frequently in middle-aged male subjects. The disease is supposed to be occasionally nothing more than an extension between the muscular bundles of a chronic process that has commenced with endocarditis or pericarditis. The cause of this, which is generally rheumatism, is then regarded as the cause of the fibroid growth; but in reality it is more probable that in such cases the serous inflammation is the result, not the cause, of the fibroid change. Fibrosis is sometimes the consequence of acute interstitial myocarditis. In a considerable number of cases of fibroid disease, and in most of the cases of so-called 'fibrinous deposit,' the change is probably syphilitic in its nature. In other instances it is associated with degenerative changes in the vessels, and even infarction, or with disease of the kidneys. Increase of fibrous tissue in the myocardium may also be the result of prolonged moderate congestion of the coronary veins (*see* HEART, Congestion of). Very frequently no evident cause of the disease can be discovered.

ANATOMICAL CHARACTERS.—Our knowledge of the pathology of this disease is in a great measure due to the remarkable number of cases which have been described in the *Transactions of the Pathological Society*, since the first specimen was presented by Sir Richard Quain in the year 1850. Fibroid disease of the heart occurs most frequently in the walls of the ventricles. It is met with under several different forms. In rare instances, which might be described as cases of *connective tissue hypertrophy* of the heart, there is an uniform increase of fibrous tissue between the muscular fibres throughout the whole organ (*see* HEART, Connective-Tissue Hypertrophy of). In other instances, the disease appears as a local thickening of the connective tissue underneath an opacity of the endocardium or of the pericardium, whence septa run outwards or inwards between the muscular bundles. Most frequently, however, it presents the appearance of a *fibroid patch*, generally situated near the apex of the heart, replacing the muscular substance throughout its whole thickness, and over a greater or less extent of surface—possibly even a considerable portion of one ventricle, and consisting of dense, firm, inelastic, greyish-white fibrous tissue. Smaller patches, nodules, scars and streaks may be found in the deeper parts of the myocardium. The apices of the papillary muscles, again, may become fibroid, especially in chronic valvular disease. Polypoid *tumours*, composed of fibrous tissue, have been met with on the endocardial surface of the heart, that is, projecting into one of the cavities; more especially into the left auricle. Possibly the detachment of such a polypus may be one mode of origin of the 'fibrinous balls' or 'concretions' occasionally found lying free in the auricular cavities. Fibroid and 'fibrinous' formations due to *syphilis* are described in the article HEART, Syphilitic Disease of.

Microscopically, fibroid disease of the myocardium presents a concomitant increase of the connective-tissue elements, and decrease by atrophy of the muscular fibres. Occasionally, in an early stage, as well as at the margins of the older patches, round and spindle-shaped cells and bundles of young fibrillæ have been observed. The latter increase in size and in number, press upon the intervening muscular fibres, and finally unite and form bands or patches of ordinary fibroid tissue. Meanwhile, the muscular fibres gradually become attenuated, granular, or fatty; and at last they disappear by absorption, or patches of them may be imprisoned within the fibroid growth.

The effects upon the heart of fibroid changes in its walls vary with their situation and extent. If a large portion of the wall of one cavity is fibrotic, irregular patchy dilatation of the chamber ensues. Localised fibrosis, especially if it commence beneath the endocardium, gives rise to aneurysm of the heart, by the yielding of the diseased area to the intra-ventricular pressure (*see* HEART, Aneurysm of). Deeper or more limited patches or lines of cirrhosis cause irregularity or puckering of the cardiac walls; and valvular insufficiency may result from this, or from fibrosis and functional disturbance of the papillary muscles. Lastly, fibroid disease occasionally involves the conus arteriosus in an annular form, giving rise to constriction and the formation of so-called 'cardiac stenosis.'

SYMPTOMS.—The symptoms of fibroid disease of the heart vary greatly in different instances, according to the extent, situation, and other conditions of the growth. When the fibrosis is very limited, few symptoms can be expected to be present. In the majority of cases in which a considerable portion of the cardiac wall has been found diseased, the symptoms have been described as those of 'ordinary heart-disease,' namely, dyspnœa on exertion; præcordial pain or distress; occasional palpitation; a small, weak, or irregular pulse; dropsy; and visceral complications. As a rule, no endocardial murmur has been present; but fibrosis of the papillary muscles may sometimes give rise to the signs of incompetence of the auriculo-ventricular valves. The symptoms of cardiac aneurysm and of syphilitic disease of the heart, as well as those of connective-tissue hypertrophy, are separately described.

Course and Terminations.—The course of fibroid disease of the heart is generally chronic, although urgent symptoms are sometimes observed a short time only before death. Attacks of pain, palpitation, and dyspnœa may occur and subside long previous to the last fatal illness. The development of cardiac aneurysm, and its possible terminations, will modify the course of the disease. Sudden death may occur, with or without previous cardiac symptoms, and must be regarded as a special mode of termination of fibroid disease of the heart. Otherwise the cases generally end by pulmonary complications, dropsy, and exhaustion.

Diagnosis.—Fibroid disease of the myocardium has to be diagnosed from chronic valvular disease; from enlargement due to extracardiac causes, such as renal disease, gout, or emphysema; and from fatty degeneration. Under all circumstances, an accurate diagnosis is extremely difficult, if not impossible. The presence of a murmur does not exclude fibrosis, as the valves may become secondarily involved; and valvular disease is not always attended by a murmur. The other cardiac lesions mentioned must be excluded in the ordinary way.

Prognosis.—When fibroid disease of the heart is attended with symptoms sufficient to establish a diagnosis, the prognosis is unfavourable as regards life, although it may not be immediately so.

Treatment.—This consists in relieving and supporting the heart by every possible means, especially by rest and cardiac stimulants, such as alcohol and ether. Iodide of potassium may be given with benefit in some cases, particularly if there be a history of syphilis. Digitalis will have to be administered with great circumspection.

J. Mitchell Bruce.

HEART, Functional Disorders of.

Definition.—A disturbance in the functions of the heart, with or without pain; having origin in causes other than inflammation or organic diseases of the heart itself.

This definition comprises various disorders in the dynamical functions and sensibility of the heart, from the slightest disturbance of only momentary duration, to urgent symptoms of considerable persistence. The frequency of the occurrence of functional disorders of the heart, and the similarity of many of the symptoms exhibited to those met with in organic diseases, as well as the fact that these functional disorders may co-exist with organic disease, thus greatly exaggerating the apparent gravity of the latter, render it important to accurately determine how much of the disturbance may be due to the one or to the other of these causes. Here, however, functional disorder, uncomplicated with organic lesion, will only be referred to.

Ætiology.—To estimate the *immediate* or *proximate* cause of functional disturbance of the heart, regard must be had to its structure, and how this is nourished and its motions regulated. For adequate and equable dynamical movement, the primary requirement is a healthy development of muscular structure. Weak muscular fibre, apart from degenerations by disease, becomes a predisposing cause of feeble and irregular action. But as the regular recurrence of the muscular contraction and expansion must, moreover, be ascribed to the agency of the cardiac ganglia, the vagus nerve, and the nerves and ganglia of the sympathetic system, all nourished and excited by the blood, any abnormal conditions of these have also their effect: the contractions of the heart being inhibited by impressions made on the terminations of the vagus, and accelerated by such as may be made upon those of the sympathetic. Through the medium of these impressions, afferent and efferent, the heart's action is remotely regulated by the cardiac centre in the medulla. Interference with the functions of these several nerves may so modify the action of the heart as to cause deficiencies of power of every variety and extent, giving rise to illustrations of abnormal contractility and irritability, which the heart exhibits in common with all other muscles. The heart further possesses the distinguishing feature of rhythmical action: and this action is also shown by experiment to be immediately dependent on the blood, whether venous or arterial; for without a supply of blood rhythmical action ceases. There are cogent grounds for the belief that this is not only thus due to the intrinsic ganglionic system of nerves; but, as errors of rhythm are certainly induced by such causes as improper diet, dyspepsia, the presence of worms, constipation, injuries or deformities of the chest, and diseases of the lungs, there can be no doubt that the heart is also liable to reflex irritation of the pneumogastric and sympathetic nerves. The healthy action of the heart, and the controlling energy of its nerves, greatly, if not entirely, depend on the supply of healthy blood; and any abnormal condition of the supply, whether in quantity or quality, shows itself by disturbance not only in the functions of the heart, but in the substitution of hæmic murmurs for the normal sounds. Morbid conditions of the general arterial and venous systems have also their influences; thus the force and frequency of the pulse, and, more especially, the amount of the peripheral resistance, causing in their tubes dilatation or constriction through the vasomotor or dilator nerves, and, indirectly, the compensation and relief afforded by the abstraction of fluid through activity in the Malpighian tufts of the kidneys, are to be duly considered. Moreover, the muscular substance of the heart itself is nourished by the blood circulating in the coronary arteries, and thus becomes susceptible to the quality and condition of the blood so distributed; hence, a blood too rich in fibrin or red globules, and thereby inducing plethora, frequently causes over-action of the heart and palpitation, whilst in anæmia a deficient amount of blood induces a weak and often excited and irregular action. The predisposing causes, in addition to those already named, may, therefore, be classed thus: (1) Those conditions acting through or upon the nervous system, such as the general exhaustion of the nervous system, all forms of reflex irritation, venereal excesses, vain longings, purposeless occupations and amusements, protracted mental exercise, abstinence from adequate repose, &c. To these must be added the special temperament and personal peculiarities of the individual, a congenital or superimposed want of vigour, general debility, deformities of the ribs and spinal column, a small weak heart, uterine irritation, hysteria, adynamic fevers, and the special sanitary influences under which the individual is placed. (2) Those conditions acting upon the general blood-supply of the body, and consequently affecting the special blood-supply of the heart, such as the turgid and plethoric states of gross feeders, depraved states caused by bad and deficient diet, and all forms of blood-disorder, as anæmia, gout, scurvy, &c. Amongst the immediately exciting causes may be named mental shock or distress; protracted and unusual physical exertion; various articles of diet, as tea, coffee, &c.; tobacco in excess; many medicines, as aconite and digitalis; as also prolonged abstinence, exposure to cold, and notably blows on the epigastrium.

Symptoms.—An increased impulse, indicating a state of general plethora or surcharged circulation, is usually associated with a series of well-marked symptoms, when rapidity of action is superadded—such as flushing of the face; heat and pain of the head, with a sensation of a whizzing, or rushing upwards of the sounds of the heart; dimness of vision, with photophobia; and a tendency to syncope, and to clammy perspirations, with cold shivering. In some rare cases the voluntary muscles, more especially of the lower extremities, may refuse to act, so that the gait becomes tottering, or the patient grasps adjacent objects to steady himself, yet there is neither paralysis nor vertigo. The respiration, though not generally embarrassed, may become irregular and oppressed, presenting the phenomena of a short inspiration with a prolonged expiration; but should the right heart be congested, independently of any frequency of cardiac impulse, the breathing may be accelerated and accompanied with dyspnœa, or even apnœa, and a short dry cough. Illustrations of this class of symptoms often occur in those of sanguine and nervous temperaments; and may be the result of violent and too protracted exercise, of emotional excitements, or of the over-indulgence in stimulants or food when associated with lives of idleness and inactivity. Should the increased impulse be associated with rhythmical disturbance, there is for the most part consciousness of the existence of such states, more especially on the first ingress of the attack, so that it becomes a source of much anxiety and even of terror, inducing the self-conviction of the existence of organic disease. The head-symptoms also become more marked, and associated with local pains and *tinnitus aurium*; whilst the breathing is marked by sighing, and often becomes lessened in frequency. The irregular form of nervous palpitating heart is often associated also with hæmic diseases, and with nervous affections, as chorea, disturbances due to masturbation, &c. When such diseases as scurvy or chlorosis exist, the attacks become more persistent; there is an increase of pectoral complication, even to dyspnœa; the headache is sometimes so bewildering that the mind becomes alarmed with vague apprehensions of danger, which give rise to general restlessness; the integuments over the region of the heart, as well as of the face, and even of the extremities, may become puffy and œdematous, especially in cases of extreme chlorosis, with enlargement of the thyroid gland and exophthalmos, where the morbid conditions inducing these may also possibly cause the irregular palpitation.

When functional disorder occurs with a diminished impulse, the general symptoms group themselves under anxiety and lowness of spirits, or actual despondency, with mental and bodily incapacity for exertion; flatulent dyspepsia, with cold clammy extremities; anorexia, or, may be, depraved appetite; exhaustion, with tendency to faintness; and, should irregularity of cardiac action be very marked, there may be a sensation of præcordial pain. Males are more subject to this form of functional disorder than females, and it chiefly occurs in persons having a normally small and feeble heart, or where a state of general nervous debility is superimposed.

When the distinctive feature of functional disorder is rhythmical error, and this is appreciable to the patient, the special symptom is that of extreme anxiety, even to the fear of impending death; occasionally a single intermission is so prolonged as to induce the impression that escape has only occurred by a miracle. These alarms often induce a palpitation not belonging to the rhythmical disorder. But if the rhythmical error be associated with a deficiency of systolic force, temporary paralysis of the heart's action or syncope may be induced, and in some extreme cases the functions may be weakened even to extinction. Such forms of disorder occur in those having normal but weak hearts; in the dyspeptic; in those subject to gout, especially if an attack is impending; and in those whose habits and occupations involve exhaustion of the nervous system. They are a characteristic of advanced age, but may be sympathetically induced in the young; and may be observed in the course of many diseases, such as tuberculosis, rheumatism, liver affections, or when malignant disease is making its ravages.

Functional disorders of the heart are not infrequently associated with pain. This may have its origin in the structural relations of the heart, though the heart itself be in a normal condition; or its seat may be confined to the præcordial regions. When occurring in the former, its primary source may be in gastric injury or irritations, or caused by other foreign disease transmitting its influences through the sympathetic system; or it may be due to mental distress, in which case the vagus, probably the depressor nerve, proceeding therefrom, and the ganglion of Remac are the immediate causes of spasm. Fainting from emotion is admitted to be due to reflex inhibition of the heart, the afferent impulses reaching the medulla through the vagus; and it may be concluded that this is also the case when pain is the result. In some rare cases, pain thus occurring may be the indication of urgent, or even of fatal, disorder; this is evidenced by the well-known effect of a severe blow in the epigastrium, or in cases of sudden mental shock. These are illustrations of purely functional angina pectoris; but for the most part this symptom has its origin in structural lesion of the heart itself. *See* ANGINA PECTORIS.

Præcordial pain is by no means an unusual symptom accompanying functional affections of the heart; it may aggravate the urgency of these disorders, yet appears to be little influenced by them. The pain does not march *pari passu* with the irregularity or strength of the impulse. The pain may be persistent, while the associated disorder is in abeyance; and in this respect it differs from *præcordial anxiety*, which is essentially only temporary, though often persistent in its duration, and acquires urgency from the symptoms with which it may be associated.

PHYSICAL SIGNS.—The physical signs referring to the cardiac action may be conveniently separated into the following groups, although in practice they will be found mingled or associated with each other: (1) *Increased or diminished impulse*, connected or unconnected with increased rapidity or rhythmical irregularity; (2) *rhythmical disturbance*, with intermissions, the impulse being normal or diminished; (3) *increased or diminished frequency*, the rhythm and force being normal; (4) *hæmic murmurs*, both of the left and right sides.

(1) The cases in which an *increased impulse* is the distinctive feature of the heart's disturbance present many varieties, chiefly referable to force and regularity; but to the simple forms of increased and accelerated impulse there is so very frequently added rhythmical disturbance, that this complication is perhaps the one most usually occurring. The rhythmical disturbance may occur both in the force and the rapidity of the systolic contractions, or it may result in a true intermittence, or occasionally the irregularities thus induced may be so great as to defy definite appreciation, save as a tumultuous whole. On palpation, the impulse, abrupt in stroke, presents the characteristic of a sudden bound, now strong, now failing, sometimes so rapid as to communicate the impression of a fremitus or agitation, then a pause or true intermittence followed by hurry or more evident irregularity; but amid all this irregularity the pulse preserves, in an unbroken surface-wave, the characteristics of efficient valves. On auscultation, the sounds are more difficult of appreciation than in simple palpitation; they are loud and clear, and sometimes so exaggerated and pronounced as to be audible both in the mammary and epigastric regions. But whether the exaggerations of sound and impulse be more or less, they will be found to act in unison with each other; the impulse and sounds increase together and diminish together. When there is an unusual amount of irregular functional excitement in systole, there may be occasionally heard, as a passing, but not persistent occurrence, a reduplication of the second sound, very rarely of the first; and usually the first portion of the divided or cleft sound is the most accentuated. This reduplication, though it may be met with in active inflammatory diseases, is chiefly the concomitant of functional disorders of the nervous heart. The pulse is generally sharp and jerking; it does not always beat in unison with the systole of the heart; if there be plethora, it has a force and fulness not otherwise observable; and if there exist congestion of the right ventricle, it becomes contracted and diminished in force.

In cases where the *impulse is diminished* in effort, the special characters are somewhat negative; the impulse and sounds being feeble, but otherwise normal, unless the systole be excited by mental shock or any undue bodily exertion, when irregularity and increase of impulse, with some slight sharpness of the sounds, take place. The first sound may suggest, rather than have, a sharp ringing tone; while the second is prolonged.

(2) With respect to errors in *rhythmical action*, separately considered, it must here be noted that the chief and characteristic errors may be classified under the distinct heads of irregularity and intermittence. Irregularity may be in the force or in the frequency of one or more beats, and presents the many varieties which a want of normal uniformity may suggest; the minute and particular enumeration of these is rather satisfying to curiosity than instructive. It is sufficient to say that every variety of irregular frequency may occur; while, with certain beats, force may be increased or diminished. Sometimes there appears to be a kind of order in rhythmical disorders—that is, short series of varying irregularities may regularly succeed each other; there may be a fluttering or trembling, or that vibratory or vermicular motion to which the term 'thrill' has been given. True intermittence is not so frequent as irregularity; but when intermittence does occur, it is generally associated with irregularity. These disturbances may bo only momentary or of long duration, slight or considerable; but, however this may be, their character is determined by the irregularity in the recurrence of the systolo, and the consequent prolongation or retarding of the period of intermission in the systole.

The physical examination of this form of functional disorder shows no marked peculiarities, excepting those of systolic irregularity. To the ear is revealed irregularity in the recurrence and duration of the sounds, from the slightest appreciable pause to the most rapid and confused trembling, with very manifest alterations in tone and pitch. The sounds generally are intensified, the first sound being sometimes heightened to the extent of a sharp knock; whilst the second, save in intensity, is not materially altered. In extreme cases there may be so much ventricular irregularity as to induce in place of sounds an ill-defined fremitus; and so much force as to produce a metallic ringing, with a rubbing murmur on the systole. Thus the impulse of the heart, which in health is rarely appreciable, and its friction never, respectively become so to the touch and to the ear; and the abnormal sounds may exist to such an extent as to entirely obscure the normal first sound.

Occasionally there is met with an appreciable rhythmical disturbance in the pulse, which is not found to exist in the heart—*falsc intermittence*. The heart only indicates irregularity of power; and as there is occasional failure of force in the already weak systolic contractions, the impulse is not communicated to the artery at the wrist. These false intermissions accompanying irregularity most frequently occur when the heart is oppressed by flatus in the neighbouring viscera, or is excited by injurious articles of diet, as tea, or by the use of tobacco. The sensation communicated to the patient is that of a disagreeable flutter or 'tumbling over' of the heart, which tends to alarm, although habit may to a certain extent ameliorate the terror.

Rhythmical irregularity occasionally appears as a normal condition, having a lifelong existence. Some cases are marked by an extension of the pause, with unsteadiness of the systolic impulse; others by its apparent extinction, so that there exists a rapidity of beats defying all analysis—tachycardia; but tachycardia also occurs either as an habitual state, or in paroxysms (*see* TACHYCARDIA). There is in these cases usually a small weak heart, with systolic impulse devoid of energy. Both these classes of cases present the remarkable feature of losing much of their distinctive irregularity when under the influence of a febrile attack; the slow pulse becomes quicker and more steady, the rapid one less frequent and more distinct; but the sensation to the individual is, nevertheless, not so comfortable as when the heart's action is in its state of normal irregularity.

(3) Functional disorder occasionally assumes the form of either increased or of diminished *frequency*, while the force and rhythm remain normal. Each of these conditions may be congenital and proper to the individual, or may be the result of abnormal influences. The functionally fast beat is generally induced by other diseases, as fever, diabetes, tuberculosis, &c., and is indicative of injury to normal innervation. The slow and drawling beat is generally met with where the nerve-power is healthy, but the heart itself is weak or fatty; or there is a perverted innervation under the influence of digitalis, aconite, or injury to the ganglionic system—a blow in the epigastrium offering a familiar example.

(4) *Inorganic murmurs* are frequently heard in functional disorders of the heart, and more especially in those cases of hæmic disorder where the systolic impulse is increased, with rhythmical irregularity. These murmurs have the special characters usually attached to such sounds. They are systolic, basic, with conduction in the course of the great vessels. There is no apex-murmur; but at the apex, synchronously with the basic murmur, the first sound is clearly defined, with a metallic ringing second sound. The tone of these murmurs is musical, cooing, soft, of low pitch. The seat is in the aortic valves, and, as a rule, they are always accompanied with palpitation: this palpitation may be persistent, while the murmurs are not so. The murmurs in chlorosis and spanæmia, and, when they occur, in ichorrhæmia and leukæmia, have their seat for the most part in the pulmonary valves, and are not traceable in the course of the larger arteries; they

are also generally associated with the venous hum to be heard in the jugular veins. It is remarkable how large may be the amounts of blood drained from the system, and the frequency of the discharges, provided there be no diseased condition of the blood itself, without inducing the presence of a murmur. But under these circumstances, though there be no murmur, the first sound is usually flapping in character, and the second ringing in tone.

Complications and Sequelæ.—The several functional disorders of the heart are often complicated with other diseases—many external to the heart, and some of the heart itself. The more prominent of the former are disorders of the nervous system and of the blood. Many of these have been already referred to. For the most part, those associated with a perverted innervation are examples of irritability, and exhibit rhythmical disorder, with pain. Hæmic diseases induce the simpler forms of palpitation: anæmia, gout, and dyspepsia induce palpitation with rhythmical disorder; spanæmia and chlorosis induce all these disorders, with murmurs superadded. The diseases of the heart with which symptoms of functional disorder, though only occasionally occurring, may be complicated, are mainly degenerations of the walls and valvular lesions. In all these cases the amount and urgency of the functional disturbance of the heart are no indication of the urgency of the disease with which it may be complicated.

Are there any distinct morbid states or other sequelæ traceable to functional disorder of the heart? To answer this question dogmatically may be difficult. Doubtless frequent and prolonged attacks of functional disorder are seen to occur without inducing any such. On the other hand, the long continuance of functional disorder is often marked by a depreciation of mental and bodily vigour. More specific organic changes are generally found to be due to some one or other of the diseases with which the functional disorder has been in its course associated.

Diagnosis.—In order to make a correct diagnosis, the first consideration is to ascertain the entire absence of structural disease; or, should it be present, whether it be adequate to cause the full amount of the symptoms exhibited. Supposing this to have been done, if the agitation of the heart is not only excessive, sudden, and apparently increased in strength, even to violence, but presents the features of spasm rather than the calmness of rhythmical order; if the sounds are *pari passu* increased in sharpness and intensity, and diffused over a larger area than is proper to them; and if the pulse does not partake of the simulated force of the heart—the presence of an excited functional impulse may be assumed. The concurrence of some symptoms usually associated with organic disease, such as dyspnœa or even apnœa and œdema, may, as has been shown, be due to the presence of chlorosis. So also where there is a deficient impulse, if the heart have its normal position and dimensions; if the sounds though weak be natural in tone and quality—it may be concluded that the cause is functional only, in the absence of any abnormal physical disease. The same may be said of rhythmical irregularities. When any of these symptoms are associated with hæmic murmurs, the character of the murmur, its seat, and its persistency must be considered in connexion with the absence or the presence of hæmic diseases. The symptoms of each of these several forms of functional disorder have been so fully described that there is no need to repeat them here. It must, however, be always borne in mind that the absence of the physical signs of disease is not always conclusive of there being no structural lesion, for there may be lesions, and important ones too, that do not yield evidence of their existence. The occurrence of the secondary changes, the immediate result of various congestions, is often an indication that the heart-symptoms are due to the presence of structural disease; still it is not always so, for congestions of the lungs and liver, and œdema, may be the consequence of spanæmia or of other morbid conditions of the blood. Hence, when these are present, the symptoms exhibited by a disordered heart may not be due to structural disease; and the same may be said of the effects of muscular exercise and of position, for either or both of these may distress if there be present any anæmic condition or an intercostal neuralgia. Nor, on the other hand, does the occasional subsidence of urgent symptoms, so frequently the case in functional disorder, absolutely affirm the conclusion that there is no structural lesion; for occasionally in the latter the normal rhythm and force of the heart may reassert themselves; but then in these cases there remain the other characteristics of the organic affection. Repeated examination and an accomplished experience will generally lead to a just diagnosis.

Prognosis.—The prognosis of functional disorders of the heart, for the most part, is favourable. Where there are baneful constitutional tendencies, or complications with other diseases, the prognosis must not, however, be always so considered. In the leucophlegmatic temperament the symptoms may be severe and abiding, and generally distressing to the nervous system. If the disordered condition be so urgent as to distend the right heart, the liver may become loaded, and dropsy thence ensue. In this temperament mental shocks may induce palpitation, irregularity, and syncope, whence may ensue not only persistent disorders, having reference to these symptoms, and eventually disease, but even immediate death. When functional disorder is the concomitant of scurvy or anæmia, the prognosis is not always favourable. Still in the young and middle-aged there is good chance of ultimate recovery; for if these diseases be subdued the functional disorder subsides. When occurring in the aged, or in those having a constitutional tendency to hypochondriasis, or when associated with structural diseases, or excited by inflammations of the endocardium, a less favourable prognosis must be given. Functional rhythmical irregularity, for the most part, does not indicate danger, but it may do so if associated with some obscure structural lesion. Nevertheless, cases of simple functional disorder, so severe as apparently to indicate an immediately fatal termination, prove, for the most part, manageable, and result in a restoration to health. The freedom of the heart from all agitation and other indications of disease, before and after an attack, is due to its being a normal and uninjured organ; and though liable during an attack to the morbid influences of spasms and congestive loading, it still may be a healthy organ. This holds whether the periods of disorder be short or prolonged, occurring rarely or frequently recurring. They are distressing but not dangerous.

Treatment.—The treatment of functional disorders of the heart should have reference primarily to the mitigation of the symptoms; and, secondly, to the prevention of their recurrence by avoidance or cure of the exciting causes.

Treatment during the paroxysms.—Functional disorder with increased impulse accompanied by accentuation of the second sound is to be met mainly by depletory measures. If the symptoms present an aspect of urgency, venesection is called for; but otherwise the promotion generally of the secretory and excretory functions, especially through the portal and renal systems, and the enforcement of a regulated, unstimulating dietary, are the measures to be resorted to. The medicines thus indicated are the alkaline diuretics and the saline aperients, and either colchicum or mercurials in occasional alterative doses. When rapidity of action is superadded, there are two classes of remedies to be resorted to—either sedatives, or the excitants of the inhibitory nervous influences of the vagus. Of the former, aconite, bromide of potassium, diluted hydrocyanic acid, and lobelia are types; of the latter, digitalis and strophanthus are the most reliable; but convallamarin, adonidin, and scillain are members of the same group. When there is diminished impulse or malnutrition of muscle, the causation, as in spanæmia or scurvy, must be met, and the remedies to be adopted are either the sedatives with stimulant action, such as bromide of ammonium or camphor, or the nervine stimulants, such as sumbul, valerian, or castor. Functional aortic murmurs, generally assumed to be indicative of spanæmia, are to be met by blood tonics, of which iron is the type; but sometimes they would appear to be strictly neurotic in origin, as in some forms of chlorosis, when the nervine tonics, represented by arsenic, zinc, or phosphorus, are preferable. The cause of intermittence is often to be found in the abuse of tea (the tasting habit), and of tobacco; otherwise it is generally to be viewed as a nerve failure, to be remedied by tonics, especially the simple bitters combined with ammonia and stimulants. When irregularity, on the other hand, whether with increased or diminished impulse, is more than probably due to an irritable state of the sympathetic or intrinsic cardiac ganglia, arising in some instances (as in gout) from irritative causes within the blood, sedatives, and especially the alkaline sedatives, are called for. If it be induced by a temporary paresis of the inhibitory centres, whether of the vagus or the ganglion of Ludwig, stimulants are needed. The abuse of digitalis and the like produces irregularity, firstly of the pulse, then of the heart. This becomes, therefore, the warning note in the administration of digitalis; belladonna, on the contrary, excites the action of the heart through the motor ganglia, and can partly annul the inhibitory nervous power when this is not influenced from the medullary centre.

Treatment between the paroxysms.—The paroxysm being allayed, it is then well to examine carefully into the state of the health, so as to ascertain if there be any of those disordered conditions which may probably have been its exciting cause. Dyspepsia is to be relieved, the liver is to be set right, the uterine functions are to be restored to regularity, loaded bowels relieved, plethora subdued; spanæmia and chlorosis strengthened into health; exhaustion compensated for, and debility counteracted; and the overworked must seek renovation in travel and cheerful recreation. In persons prone to these disorders many precautions should be observed. The young and the plethoric must avoid extremes of diet and exercise; the food should be moderate in quantity and unstimulating in quality; and exercise should be unfatiguing, and chiefly taken in the open air. Hot and ill-ventilated rooms, and the postponement of sleep by late hours, should be especially avoided. A careful mental discipline should be observed; and this must be sought in a healthy exercise of the brain, and restraining, by a well-ordered intellectual culture, the tendency to vain imaginings and emotional passions. The constitutionally nervous and irritable in mind must sedulously avoid exciting situations, as well as exhaustion by overwork. The sluggish and hypochondriacal must resist the temptations to inaction, seeking to overcome these tendencies by exercise, healthy mental occupation, and cheerful companionship; by cold bathing, more especially by means of the shower-bath; and, if the bowels be confined, by the judicious use of aperients. As all the varieties of functional disorder of the heart are peculiarly under the influence of a morbid will, it becomes of the first importance that the medical attendant should generally encourage and cheer; and as soon as careful investigation has satisfied the requirements of a just prognosis, further investigations by the stethoscope should be avoided. Repeated investigations tend to prolong the disordered action, and perhaps so to impress the imagination as to forbid recovery.

THOMAS SHAPTER.

HEART, Hæmorrhage into the Walls of.

—SYNON.: Cardiac Apoplexy.

DEFINITION.—Extravasation of blood into the substance of the heart.

ÆTIOLOGY AND PATHOLOGY.—Blood is extravasated into the substance of the heart in various pathological conditions, but as these are described under their respective headings, it will not be necessary in this place to do more than refer to them.

Rupture of the heart is the most frequent origin of hæmorrhage into the walls of the organ. The blood in these cases may be derived from the cavity of the ventricle, and forced between the muscular fibres at each contraction. More rarely, a partial rupture of the wall may occur, unconnected with the cavities, and hæmorrhage take place into the seat of the lesion from one of the coronary vessels or their branches, constituting what has been called 'cardiac apoplexy.' In both classes fatty degeneration is generally the cause of the rupture.

The formation of false consecutive *aneurysm of the heart* may be attended with hæmorrhage into the walls; an abscess, blood-cyst, hydatid-cyst, or gumma having burst or made its way into one of the cavities.

The *coronary arteries* may be the source of the hæmorrhage: for instance, in rupture of a coronary aneurysm; in cases of cancerous ulceration of their walls; and in embolism or thrombosis of their lumen, leading to infarction.

Ecchymosis of the heart is a form of hæmorrhage belonging to a different category. It is generally met with in association with parenchymatous degeneration of the heart, for example in the acute specific fevers; with that form of fatty degeneration which is produced by certain poisons, such as phosphorus and arsenic; and with other pathological states in which ecchymoses occur in the viscera generally, as in purpura and scurvy, and especially in cardiac and pulmonary disease.

In cases of non-fatal hæmorrhage into the walls of the heart, the blood undergoes the changes usual in extravasations, and gives rise to the collections of pigment-particles which are sometimes found between and upon the muscular fibres; to blood-cysts; or to collections of puriform matter.

Hæmorrhage into the myocardium, whatever its pathology may be, possesses no special clinical relations.

J. MITCHELL BRUCE.

HEART, Hydatid Disease of.

—A considerable number of cases have been recorded, in which hydatids, in the wider sense of the term, have been found in the human heart. According to the late Dr. Cobbold, 3·5 per cent. of all cases of hydatids in man occur in this situation.

ANATOMICAL CHARACTERS.—Hydatid cysts of the heart are either simple or multiple, the latter being the more common of the two forms. They are situated in the myocardium of either side of the heart; but tend naturally by enlargement to project either into the pericardial sac, or into one of the cardiac cavities, in the form of a prominent cystic tumour. In this condition they have generally been found *post mortem*; but it is probable that in other cases the parasite may undergo degenerative changes in the heart, as in other organs, without its existence being suspected during life or discovered after death. In still other instances the hydatids rupture or are dislodged from their seat in the cardiac wall—either inwards or outwards or in both directions at once. In the first event, the parasite or its contents or fragments becomes impacted in the cardiac cavities or orifices, or give rise to embolism of the great vessels or of a distant branch. Rupture of a cyst into the pericardial sac causes pericarditis; and rupture both internally and externally has given rise to hæmato-pericardium.

Hydatids of the heart are frequently associated with the same disease in other viscera. The appearance and structure of the parasite do not require to be described here. *See* ENTOZOA.

SYMPTOMS.—In several cases of this disease, the subjects have died suddenly during exertion; or, as in a case recorded by Dr. Wilks, after a hearty meal. These persons were not known to have suffered previously from symptoms referable to the heart. In other instances the ordinary phenomena of chronic cardiac disease were present, including endocardial murmurs; but it is not certain that these were always due to the presence of the hydatids in the heart. A sudden fatal termination will be the result of internal rupture and embolism, or of hæmato-pericardium, as described above.

DIAGNOSIS.—Hydatid disease of the heart does not appear to have ever been suspected during life. Cardiac symptoms and signs, or sudden death, occurring in an individual known to be suffering from hydatids of other viscera, would suggest that the heart was possibly also affected.

Treatment.—The disease cannot be said to have any special interest therapeutically.

J. Mitchell Bruce.

HEART, Hypertrophy of.—Synon.: Fr. *Hypertrophie du Cœur*; Ger. *Hypertrophie des Herzens.*

Definition.—An excessive growth of one or more of the tissues of which the heart is composed, the result of which is an abnormal increase in the weight and bulk of the organ.

The walls of the heart are composed of muscular tissue, connective tissue, and fat; and an increase may occur in any one of these elements. Here we have to deal with hypertrophy of the muscular tissue. Increase of the fat and of the connective tissue will be found described under Heart, Fatty Growth on; and Heart, Connective-Tissue Hypertrophy of, respectively.

Anatomical Characters.—The most important anatomical change in cardiac hypertrophy is an increase of the proper muscular tissue of the heart. There is no growth of new tissue different from the normal heart-muscle: there is an increase in the number and it may be in the size of the muscular fibres. There may be hypertrophy of only one part of the cardiac walls, abnormal thinning being found in other parts. The organ may be greatly enlarged from general dilatation, without any notable thickening of the walls; but the capacity of the chambers should always be carefully noted in estimating the degree of hypertrophy, as there may be a greatly augmented *extent* of wall, although its actual thickness seems normal. Simple hypertrophy is very frequently the first condition, preceding hypertrophy with dilatation. *See* Heart, Dilatation of.

The increase of weight and bulk may be due to (1) augmentation of the size of the muscular fibrillæ, which may become more than double that of the normal; (2) the formation of new muscular fibres; (3) increased development of blood-vessels; (4) augmentation of connective tissue; and (5) fatty accumulation. In the course of time the hypertrophied tissue may unduly press upon the blood-vessels and contribute to induce degeneration, whilst the continuance or increase of the primary cause of obstruction may lead to dilatation of the cavity (auricle or ventricle), the work of which is obstructed.

General Considerations.—The weight of the heart of the infant at birth becomes more than doubled at the age of two years. Between seven and fourteen years of age it is about eight times the weight at birth; from fourteen to twenty the increase is such that the weight is again nearly doubled. There is, speaking generally, progressive augmentation even to old age. Wilhelm Müller, however, has shown that the progressive increase of weight with age is due rather to the augmentation in the weight of the great vessels within the pericardium than to that of the heart-substance itself. There has been a general consensus amongst observers that the heart of the male is, as a rule, heavier than the heart of the female. W. Müller has shown, however, that this is only because the weight of the heart is proportionate to that of the body. Up to the body-weight of 44 lbs. the heart is relatively heavy as compared with the body, whilst from 44 to 176 lbs. its proportional weight diminishes. Witness the extremes as following: Proportion of weight of heart to that of body, ages 1 to 10, male ·0059; ages 80 to 90, female ·0028.

The average weight of the female being less than that of the male, the heart of the former is of course less. It will be readily seen that, as the weight of the heart varies with that of the individual, one cannot express with exactitude any figure as the normal weight. We may roughly say that the heart of the adult should weigh about 10½ oz. One that weighs 12 oz. is hypertrophied. The weight of a hypertrophied heart may vary between this and the enormous figure of 60 oz., which has been recorded; not uncommonly it reaches 27 to 30 oz. In taking the thickness of the muscular walls of the ventricles as a standard, we may regard a left ventricle of an adult as hypertrophied when the breadth of the thickest portion surpasses six-tenths of an inch, and a right ventricle as hypertrophied which measures over a quarter of an inch. In hypertrophy the thickness of the left ventricular wall and of the septum has been found as great as 30 and even 40 millimetres (1¼ inch and 1⅝ inch). The columnæ carneæ may be greatly enlarged in hypertrophy, but the hypertrophy chiefly tells upon the walls of the ventricle.

The walls of the auricle may be considered as hypertrophied when the thickness exceeds 4 millimetres (about one-eighth of an inch).

Varieties of Hypertrophy.—Bertin in 1811 described three forms, which most succeeding writers have referred to, namely: (1) *simple hypertrophy*, in which the parietes of the compartments are thickened, the cavities retaining their natural dimensions; (2) *hypertrophy with dilatation* (*eccentric hypertrophy*), in which the cavities are increased in capacity, while the parietes are either of natural or of augmented thickness; (3) the so-called *concentric hypertrophy*, or *hypertrophy with diminished cavities*, in which new material was supposed to be added, chiefly in the interior of the ventricular walls. Cruveilhier and Budd pointed out that the condition called concentric hypertrophy is the result, not of hypertrophy, but of a powerful contraction of the organ suddenly arrested, as it were, by death. Budd found that the hearts of persons who had died a violent death presented this so-called concentric hypertrophy; but that such hearts became relaxed, and showed the normal size of cavities and thickness of walls after maceration. Rokitansky and Bamberger acknowledge the rarity of concentric hypertrophy, but think it does sometimes occur. There can be little doubt that *concentric hypertrophy* of the ventricles has no real existence. The appearances which have given origin to the term are due, in the great majority of instances, to the occurrence of *rigor mortis* in the muscle of the ventricle, which has caused firm contraction and thus diminution, to almost obliteration, of the cavity. If a heart presenting such signs be soaked for some hours in warm water a gentle dilatation with the finger will restore the ventricle to its normal dimensions. The left ventricle may simulate concentric hypertrophy in some cases of mitral stenosis when the disease has developed in early childhood. The ventricle has not received its normal blood-contents, and development has proceeded disproportionately in the right chambers and the left auricle. The cavity of the left ventricle has thus been left relatively small till the time of death. In like manner, in congenital stenosis of the pulmonary artery the *right* ventricle, hypertrophied in intra-uterine life, may so continue, and its cavity never become dilated to the normal extent. The ventricles are much more frequently hypertrophied than the auricles, and the left ventricle more frequently than the right; but the right auricle more frequently than the left auricle—which last shows the change very seldom.

I. Hypertrophy of the left ventricle. Anatomical Characters.—The whole heart appears to be elongated, and the apex-portion of the left ventricle especially prolonged. The walls of the left ventricle and the interventricular septum are thicker and firmer than in the normal: the septum may bulge into the right ventricle, diminishing its capacity and even producing actual obstruction of its conus (Coats). In transverse section the thickening and bulging of the septum are very manifest, the right ventricular cavity presenting the appearance of a crescentic appendage to the left chamber.

Ætiology and Pathology.—Sir Richard Quain (*Lumleian Lectures*, 1872) has classified the *exciting* causes of hypertrophy under three heads—*nervous*, *mechanical*, and *nutritive*.

(1) Amongst *nervous* causes are prolonged mental excitement or strain, and those emotional conditions which produce frequent palpitation. The immoderate use of strong coffee, tea, or spirituous liquors might come under this head. It is not in all cases that a heart which beats for long periods at an abnormal rate of rapidity becomes hypertrophied, inasmuch as the general nutritive processes may be feeble or imperfect in some persons, active or vigorous in others. In cases of rapid heart (tachycardia) the writer found evidences of enlargement in three only out of seventy-five cases; in some the heart seemed even smaller than the normal. In Graves's disease, when there has been abnormal rapidity of heart, persistent or paroxysmal, for several years, the cardiac area has been sometimes found not larger than under conditions of health, and in many cases the *post-mortem* examination has demonstrated no morbid change. The just conclusion, therefore, seems to be that for the production of hypertrophy of the left ventricle in cases of nervous excitation there must be an additional factor to rapidity—either a thickening of the arteries, or a vaso-motor irritation causing contraction of their muscular walls, whereby the intra-arterial tension is increased, or a quantity or quality of blood affording better nutrition. If the blood-pressure be at or below the normal, the rapidly beating heart does not tend to hypertrophy.

(2) Amongst *mechanical* or *physical* causes are all those obstructive conditions to be specially examined presently. Violent and long-continued athletic or other exercises, which notably accelerate the contractions of the heart, or produce excessive blood-pressure, may be mentioned here. It has been pointed out that great muscular exertion with the arms is specially prone to cause hypertrophy, as in the case of hammer-men, &c. Prolonged working in a bent or constrained position is also mentioned as a cause.

In some callings and conditions in which muscular effort is severe, hypertrophy of the left ventricle is prone to occur—*e.g.* Cornish miners (Peacock), dwellers in hilly regions, especially those accustomed to carry heavy loads (Münzinger, Allbutt), stonemasons, slaughterers (Leyden). In many cases it is probable that the two factors just mentioned —nervous excitation and muscular overstrain—combine to produce the hypertrophy. So may be best explained the signs and symptoms in the cases of 'irritable heart' of soldiers during the American Civil war (Da Costa), those in our own Foot Guards who carried heavy accoutrements (Myers), and those in the Franco-German war (Fraentzel) (*see* Exercise). The excitement of a soldier's life co-operates as a cause with the muscular effort, which may be excessive and either prolonged or violent and fitful. It is a significant observation of Hirsch that there has been a notable increase in the proportion of heart-diseases in a community at times of great political and social excitement. This was observed in France during the great Revolution and after the political agitation of 1830, in Rome after 1848, in Sicily in 1860, and in the Argentine States after the political confusion and civil war.

(3) *Diseases of the valvular apparatus*—aortic and mitral—induce hypertrophy of the left ventricle by causing an obstruction to the outflow of blood or an abnormal blood-pressure within the cavity from regurgitation. (*a*) *Stenosis of the aortic orifice* is a common cause of hypertrophy of the left ventricle. The opening is not only narrowed, but is also rendered more rigid, and thus increased force is necessary to propel the blood. Along with the valvular lesion there may also be, especially in advanced life, a loss of elasticity and a roughening of the inner coat of the aorta from degenerative changes — conditions which increase the mechanical strain upon the left ventricle. (*b*) *Aortic regurgitation* often induces so great enlargement of the left ventricle, from hypertrophy and dilatation, that the heart in such cases merits the name *cor bovinum*. The back-flow of blood increases the intra-ventricular pressure, tends to dilate the cavity, and calls forth augmented efforts of ventricular contraction. In some cases of injury and rupture of the aortic valves it has been possible approximately to estimate the rate of hypertrophy. In two cases, related by Dr. Stone, of injury to these valves by blows upon the chest, assuming that the heart was healthy previous to the injury, there must have been an increase of nearly an ounce a week during the four or five weeks that elapsed before death. (*c*) *Mitral regurgitation*. Insufficiency of the valve at the left auriculo-ventricular orifice of necessity causes the left ventricle to be subject to abnormal pressure, with the result that it becomes hypertrophied as well as dilated.

(4) *Aneurysm of the aorta.*—There has been much difference of opinion on the question whether aneurysm of the thoracic aorta is a cause of hypertrophy of the left ventricle. The divergence is capable of explanation. When the situation of the aneurysm is at the commencement of the aorta, where it involves the semilunar valves, hypertrophy is the rule. When the aneurysm is so situated as not to involve the valves, hypertrophy is a rare exception. This is proved to demonstration by the following figures, deduced from the records of the London Hospital, the cases being collected by Dr. F. J. Smith, medical registrar. Of forty-one cases of aneurysm of the thoracic aorta in which the valves were *not* implicated, enlargement of the left ventricle was evidenced in only nine instances, and in three of these the hypertrophy was recorded as only slight. In forty-one cases in which the valves *were involved*, hypertrophy and dilatation were manifested in thirty-five.

(5) *Renal disease.*—Hypertrophy of the left ventricle may occur in all forms of Bright's disease, the lardaceous form excepted. Of these *chronic Bright's disease* (contracted kidney) is a very important cause, the hypertrophy being often of the purest type, without dilatation. This change is the result of the great increase of blood-tension produced by the resistance offered to the blood in the small arteries through the whole body, as well as in the kidneys.

(6) *Pregnancy.*—It has been shown by many observers that the left ventricle tends to become hypertrophied and the arterial tension augmented during pregnancy. The hypertrophy may continue for a considerable portion of the period of suckling, and then the heart, like the uterus, undergoes a process of involution. According to Duroziez, the ventricle tends, after many pregnancies, to remain hypertrophied.

(7) *Excess of food.*—With regard to the *alimentary* causes of hypertrophy of the heart, the state of the local nutrition and the nutritive quality of the blood have both to be taken into account. Rich nitrogenous food, and the use of ferruginous medicines, will favour hypertrophic changes. With the increase of the muscular structure there is proportional enlargement of the coronary arteries, so that the hypertrophied organ has an increased blood-supply.

Physical Signs of Hypertrophy of the Left Ventricle.—In simple hypertrophy (*e.g.* when occurring in athletic persons, or in relation with chronic renal disease in the earlier periods) the wall of the chest *on inspection* may be observed in the neighbourhood of the apex to be raised with each ventricular systole. Pulsation, also, of the carotid arteries in the neck may be observed, such pulsation being rather prolonged, and not sudden (as in aortic regurgitation), unless there be concurrent fever. On *palpation* the fingers are lifted by the apex, the impulse of which is prolonged and heaving. The duration of the heaving impulse is in proportion to the degree of hypertrophy. The impulse is often strong enough to visibly move the bedclothes, and even to raise the head of the auscultator by the impact against the stethoscope. Of course a larger portion than usual of the heart's surface impinges against the chest-wall. The outline of the apex-portion of the heart, as obtained by *percussion*, is acutely triangular, its acute angle pointing downwards and to the left. This becomes broader and more rounded as dilatation preponderates over hypertrophy. In simple hypertrophy the heaving apex may be in the sixth or seventh, rarely in the eighth, left intercostal space; but in dilatation with hypertrophy the area downwards and towards the left axilla is greatly increased. On *auscultation* the first sound at the apex is found to be dull and prolonged. It is the sound of muscular contraction that the ear in the greatest degree appreciates, the element of valve-tension being muffled by the thick wall of the ventricle. Over the second right costal cartilage the second sound is loud, and may have a ringing character; it may sometimes be the only one of the two normal sounds audible. In this situation it is much louder than over the second left interspace (the commencement of the pulmonary artery) unless the ventricular hypertrophy is accompanied by mitral insufficiency. If with evidence of powerful left ventricle and firm arteries the aortic second sound is not loud, but dull and ill-pronounced, there is strong probability that the aortic cusps are swollen or thickened from disease. In later stages of hypertrophy, when the muscular tone of the left ventricle is impaired, the sounds of the heart may have a triple rhythm, resembling the cantering of a horse—the *bruit de galop*, carefully studied by Potain. This is especially observed in the hypertrophy associated with renal disease, and in the hypertrophy with dilatation accompanying gastro-hepatic derangement.

The *radial pulse* is felt to be prolonged; the artery is firm and resisting, and its coats may be thickened. In the hypertrophy resulting from muscular overstrain the pulse is large and full, the first wave is prolonged, and there is no dicrotism. In chronic renal disease, as the arterial coats become thickened the amplitude of the pulse is manifested in less degree, the vessel being felt hard, resisting, and full between the beats. In some cases the fullest force exerted by the finger may fail to entirely obliterate the pulse, and on the distal side of the point compressed the wall of the artery may be felt cylindrical and firm. In the hypertrophy associated with aortic stenosis the pulse is somewhat narrow and gradual both in its rise and fall. In that manifested with aortic incompetency it is sudden and powerful in its impact against the finger, but rapidly receding, so that the artery seems empty between the beats—it is the collapsing or water-hammer pulse.

Symptoms of Cardiac Hypertrophy.—It must not be forgotten that simple hypertrophy may exist without producing symptoms attracting the attention of the patient, and that there is a natural tendency to some degree of cardiac hypertrophy with the advance of age. *Dyspnœa.*—In moderate hypertrophy without complication, there is usually easy and natural breathing when the patient's body and mind are at rest. But mental excitement or bodily effort at once induces more or less of temporary dyspnœa. In some cases the due expansion of the lungs may be mechanically impeded by the increased volume of the heart. In eccentric hypertrophy with dilatation, more especially when the right cavities are thus affected, pulmonary congestion and œdema are usually present, and then marked dyspnœa is a prominent and distressing symptom. *Cough.*—In simple hypertrophy there may be an occasional dry, irritating cough, and in young plethoric women a wheezing cough may be complained of. In right-side enlargements, when pulmonary obstruction and dropsical effusions supervene, cough is, in most cases, a very frequent and painful addition to the other sources of discomfort to the patient. *Hæmoptysis and other hæmorrhages.*—Hæmoptysis from capillary engorgement is common, being generally active and sudden. Niemeyer points out that, in left-heart hypertrophy, there is often active distension, and sometimes rupture, of the branches of the bronchial arteries. In left hypertrophy, too, the cerebral arteries are specially liable to give way. In right-side enlargement with pulmonary obstruction, the blockage may influence the vessels of the liver and the portal system generally, so as to produce hæmatemesis or melæna. Epistaxis may also be due to cardiac enlargement. *Palpitation* is a common symptom in all organic diseases of the heart, and is often very marked in cardiac enlargements. The least excitement, bodily or mental, may induce a greater or less degree of this symptom. Especially in eccentric hypertrophy with dilatation, most distressing paroxysms of palpitation are apt to occur from time to time. Besides bodily and mental excitement, other conditions, such as indigestion, flatulence, or an overloaded stomach, readily call forth this symptom. When there is much dilatation, the palpitation may be irregular and intermittent, and is then more particularly a very alarming symptom.

The *renal* and *urinary* derangements are very important. In the hypertrophy of the left ventricle, associated with chronic Bright's disease, there will be found the copious excretion of a pale urine of low specific gravity. Albumen may be found in small quantity, and may sometimes be absent. In the hypertrophy associated with gastro-hepatic disturbance, the urine will be scanty, of high specific gravity, often thick with urates, containing much urea, and dark with the colouring-matter of the urine, of the bile, or of both.

Certain *cerebral symptoms* ought to be mentioned in connexion with the other more direct signs of cardiac hypertrophy. A feeling of fulness, or perhaps of throbbing, may be felt in the head after great muscular exertion or mental excitement. In pronounced cases there may be headache, ringing in the ears, vertigo, muscæ volitantes, and disturbing dreams. The bright and shining, or perhaps bloodshot, condition of the eyes is an indication of the hyperæmia of the cerebral vessels.

II. Hypertrophy of the right ventricle.—The normal weight of the right ventricle is probably less than half that of the left (average in men: left ventricle 173 grammes, right 72; in women: left ventricle 150, right ventricle 62. Du Castel).

The capacity of the right ventricle is generally greater than that of the left—according to recent researches in the proportions of about seven to six. The walls are from a quarter to one-third the thickness of those of the left.

In the great majority of cases the right ventricle becomes hypertrophied only in association with a morbid change in the left, and when such hypertrophy occurs it is nearly always accompanied by dilatation. There are exceptions to this rule, as will be presently seen.

The right ventricular wall may be thickened to the extent of one inch, instead of the normal two and a-half lines; its greatest thickness is at its base. The columnæ carneæ of the right ventricle are even more liable to hypertrophy than the wall. In dilatation with hypertrophy the columnæ carneæ become stretched and attenuated. The substance of the hypertrophied left ventricle can generally be torn with ease, whilst that of the hypertrophied right ventricle is usually tough and leathery.

Ætiology and Pathology.—The right ventricle may be observed in a state of simple hypertrophy in—

(1) *Congenital anomalies of the heart.*—Chief of these is stenosis of the pulmonary artery, which in the majority of cases results from fœtal endocarditis. The obstruction may be below the valves, the conus of the right ventricle being narrowed. In each case the right ventricle becomes hypertrophied in consequence of the obstruction in front, and there is no dilatation of the cavity.

(2) In *emphysema*, *fibrosis*, and *consolidated* or *compressed conditions of the lungs*, the impediment to the pulmonary circulation induces hypertrophy with dilatation of the right ventricle.

(3) In the subjects of *curvature of the spine* the capacity of the thorax is nearly always diminished; the lungs are emphysematous, and often suffer other pathological changes. The two branches of the pulmonary artery may be unequal, owing to the differences of development of the two lungs. The right ventricle is dilated as well as hypertrophied.

(4) *Endocarditis affecting the tricuspid valve.*—It is rarely that endocarditis attacks the valvular apparatus of the right side of the heart without that of the left side participating in still greater degree, except in intra-uterine life. Byrom Bramwell has shown the great probability that when endocarditis affects the valves of the left side it frequently involves also the right, though the inflammatory changes in the latter may be evanescent. Such cause may co-operate to impair the muscle of the right heart and hasten dilatation. In some cases (and these not very infrequently) the result of endocarditis is stenosis of the tricuspid orifice, in which case the right ventricle tends to hypertrophy rather than to dilatation, whilst the right auricle becomes greatly dilated.

(5) The most common cause of hypertrophy with dilatation of the right ventricle is *valvular disease of the left side of the heart.* Whether there be mitral stenosis or regurgitation, the consequences are hypertrophy of the right ventricle to antagonise the opposing forces, and dilatation on account of the persistent overstrain.

Signs and Symptoms of Hypertrophy of the Right Ventricle.—In enlargements of this ventricle, *inspection* may reveal a rounded smoothness of the epigastrium, with perhaps some bulging of the ensiform and lower left costal cartilages. The apex-beat may be seen to be very diffused, extending towards the tip of the ensiform cartilage. Facial lividity is frequently seen; and jugular pulsation may be observed when there is tricuspid regurgitation. *Palpation* over the lower part of the sternum detects an impulse, which feels as if immediately under the hand, and usually wants the heaving character of the impulse of a hypertrophied left ventricle. Epigastric pulsation is often very pronounced. The liver-pulsation in such cases may result either from venous regurgitation or from right systolic action exerted through the diaphragm. On *percussion*, the inferior line of dulness is found to extend lower down and farther towards the right than normal, sometimes reaching an inch or more beyond the right sternal edge. On *auscultation*, the second sound over the pulmonary valves is found to be louder than over the aortic. The accentuation of the pulmonic second sound, however, is not so marked as in cases of well-compensated stenosis or insufficiency at the mitral orifice. The aortic second sound is weak, and though palpation may detect a forcible impulse at the apex of the heart, the radial pulse may be felt small and contracted. In some cases a triple sound—the *bruit de galop*—may be heard over the right ventricle.

The *radial pulse* in hypertrophy of the right ventricle is usually small and resistant. There is a difficulty in the passage of blood through the pulmonary circuit, and the supply to the left chambers is reduced in amount; moreover, the blood is imperfectly oxygenated and, containing an undue proportion of carbon dioxide, it stimulates the vasomotor influences and augments the intra-arterial tension.

III. Hypertrophy of both ventricles.—Complications and Sequelæ.—Simple hypertrophy of the heart may go on quietly for a long time, just balancing the obstructive influence, and giving rise to no other form of disease. But when dilatation coexists with hypertrophy, palpitation, dyspnœa, venous congestion, and serous effusions are the ordinary results. Diseased conditions of the arteries may occur simultaneously, or may be induced by the long-continued additional strain put upon them by a hypertrophied heart. Cerebral hæmorrhage often occurs in connexion with a hypertrophied left ventricle, as in Bright's disease; although there are always perhaps other factors, besides the mere excessive propulsive power of the heart, in the production of apoplexy. Pulmonary and general congestion and œdema are the usual attendants of mitral lesions with right-side enlargements. Pulmonary hæmorrhagic infarction (the so-called 'pulmonary apoplexy') generally results from engorgement of the branches of the pulmonary vessels, and takes place in connexion with right-heart enlargement. Sanguineous exudation in the tract of the bronchial mucous membrane may occur in left-heart hypertrophy. Persons suffering from cardiac hypertrophy are apt to be gravely affected by acute febrile diseases, because the resultant acceleration of the heart's action increases the embarrassment of the organ. Of course, hypertrophied cardiac walls are subject to the fatty degenerative changes described elsewhere.

IV. **Hypertrophy of the auricles.**—Hypertrophy of the *right* auricle is scarcely ever met with except in association with dilatation of the cavity. Simple hypertrophy is only possible in the case of tricuspid stenosis occurring in infant life. Hypertrophy and dilatation are marked in cases of mitral disease, both regurgitant and obstructive. The hypertrophy is in greater degree in the obstructive lesion. In both, but especially the latter, the auricle may be sufficiently powerful to cause a back-flow into the venous channels by its systole, and thus a venous pulsation, presystolic in time, in the veins of the neck. Hypertrophy of the *left* auricle occurs in greatest degree in mitral stenosis. One of the writers has found in such case, in a boy of nine, a left auricle varying in thickness from one-eighth to one-quarter of an inch—*i.e.* the thickness in some parts being nearly that of the right ventricle of an adult. In some cases—in children—the hypertrophied auricle may be observed to cause a distinct presystolic pulsation in the third left intercostal space at the outer portion of the cardiac dulness. As the case progresses, dilatation occurs, and the muscular wall becomes thin. An increase of dulness to the left over the situation of the left auricle is often manifested on percussion in cases of mitral stenosis.

V. **Hypertrophy of the whole heart.** This is manifested in the highest degree in cases of combined aortic and mitral disease; either when a rheumatic lesion has induced mitral and aortic regurgitation coincidentally, or when the initial lesion has been aortic regurgitation, and mitral inadequacy has resulted from the abnormal intra-ventricular pressure. In mitral disease, however, when the aortic valves are intact, the hypertrophy and dilatation of both ventricles may be very considerable. Differences of opinion have been expressed as to the influence of *pericardial adhesions* in determining hypertrophy of the heart. It can scarcely be doubted that pericarditis is a potent factor of hypertrophy during the period of childhood. A heart presenting signs of almost universal pericardial adhesion will be often found to evidence a far greater degree of hypertrophy than could be ascribed to any coexisting valvular imperfection. When the period of heart-growth has ceased, in fully adult life, the consequences may be different, and no hypertrophy, but, on the contrary, wasting, may ensue.

PATHOLOGY.—True muscular hypertrophy of the heart is compensatory, or conservative. The heart obeys the law that muscle tends to increase in force and in development when an obstacle is imposed to its normal working (*see* HYPERTROPHY; and HEART, Valves and Orifices of, Diseases of). We have just seen what the obstacles are in hypertrophy of the different parts of the heart. Some obstacles are direct, such as stenoses; and hence by this change the heart is enabled to overcome deficient valvular action or obstruction to the blood-current, the increased peripheral resistance of Bright's disease and of emphysema. Other lesions are indirect or relative obstacles, particularly valvular incompetence, which permits over-filling of the cavities, and demands a corresponding increase of vigour in the systolic discharge, which leads to hypertrophy.

DIAGNOSIS.—An extended area of dulness, displacement of the apex-beat downwards and to the left, and a slow, heaving systolic action, with augmented force of impulse, are the chief diagnostic physical signs of cardiac hypertrophy. In *young and thin people* the last of these signs may seem to be present, but the accompanying conditions readily exclude hypertrophy, especially the non-extension of the cardiac dulness. An *emphysematous left lung* may mask hypertrophy when present; and *lung-consolidation* might, though only for a moment, suggest it when absent. In *pericardial effusion* the triangular shape of the area of dulness, with the apex of the triangle upwards, is a distinctive feature; there would, moreover, be the history of an acute disease, with lancinating pain, dyspnœa or suffocative sensations, and other symptoms not found in mere enlargement of the heart. *Pleuritic effusion* or *aneurysm* would be still more readily discriminated. The differential diagnosis between left-heart and right-heart enlargements has been sufficiently discussed in speaking of the symptoms and signs. *Dilatation*, as distinguished from hypertrophy, is characterised by the feebleness and diffuseness of the apex-beat, which may even be quite imperceptible; by the great irregularity and intermittency of the heart's action; and by the general signs and symptoms of a feeble circulation.

PROGNOSIS.—Simple, uncomplicated hypertrophy, as in the young and in athletes, is not incompatible with long life, if the cause be removed in time. According to the extent and degree of complication, whether in the form of valvular lesions or co-existent pulmonary disease, the prognosis will be unfavourable. When the cardiac change is itself producing secondary lesions, as degeneration of the arterial coats, when dilatation is advancing, and when there is Bright's disease, the prognosis becomes very unfavourable.

TREATMENT.—Hypertrophy being in itself a conservative change, protective from worse results, tho primary object is to remove, if possible, the cause of the hypertrophy. To aim merely at reducing the hypertrophy, irrespectively of its cause, as by lowering the nutrition, would gravely favour the worse evil of dilatation. General therapeutic principles, and the morbid conditions accompanying the hypertrophy, must therefore be carefully attended to. All mental and bodily exertion which excites the circulation must be scrupulously avoided. Alcoholic stimulants should be taken sparingly, and no more wine allowed than such as may seem to benefit digestion. The diet should be carefully selected, nitrogenous food being generally necessary. The digestive organs must be sedulously looked after, not only because good nutrition is very important, but also because flatulence and dyspepsia directly embarrass the heart's action. Mild saline and aloetic aperients with alteratives should be given. Diuretics will be necessary if there is a tendency to dropsy, and in all cases great attention must be paid to the removal of congestion when it affects important organs, and the restoration of their functions when affected, more especially of the liver and the kidneys. When there is great excess of cardiac action, direct cardiac sedatives, as aconite, diluted hydrocyanic acid, conium, and perhaps the local application of ice, may be called for. When there is dilatation or feebleness of texture with the hypertrophy, iron and digitalis are the chief remedial drugs.

J. R. WARDELL. A. E. SANSOM.

HEART, Inflammation of.

—Inflammation of the heart may affect either the lining membrane, or the substance or walls of the organ; and the subject will be best discussed under the separate heads of *endocarditis* and *myocarditis.* Inflammation of the investing membrane of the heart is described in the article PERICARDIUM, Diseases of.

I. Endocarditis.

—SYNON.: Fr. *Endocardite*; Ger. *Endocarditis.*

DEFINITION.—Inflammation of the lining membrane of the heart.

Three forms of endocarditis are commonly described: (1) Simple endocarditis; (2) Ulcerative endocarditis; and (3) Chronic endocarditis. Only the two first forms will be discussed here; chronic endocarditis is referred to under the head of HEART, Valves and Orifices of, Diseases of.

1. Simple Endocarditis.—ÆTIOLOGY. Endocarditis generally occurs in association with acute rheumatism; less frequently with other acute specific febrile diseases, such as scarlet fever, measles, tonsillitis, erythema, pyæmia, and septicæmia—including puerperal fever; much more rarely with typhoid fever and variola. It may be observed in the course of pregnancy, and after parturition; in acute and chronic Bright's disease; and in syphilis. Injuries of the heart, such as rupture of the valves, may also lead to endocarditis; and local endocarditis is frequently the result of the unnatural contact of one part of it with another during the cardiac revolution, as, for example, by growths from the walls or valves, or by unnatural blood-currents. It is also common in chorea. Possibly it may be idiopathic.

Age is an important predisposing factor in the ætiology of acute endocarditis, the occurrence of which as a complication of acute rheumatism is certainly most frequent in young subjects, and declines as age advances. Women also are more subject to rheumatic endocarditis than men.

The localisation of the endocardial inflammation appears to be determined chiefly by pressure and tension, rather than by any peculiarity of the membrane itself, or of the blood in contact with it. Thus the left ventricle is almost the sole seat of the disease (at all events of readily recognisable degree) in the adult, and the right ventricle in the fœtus; whilst endocarditis is rarely seen beyond the boundaries of the valves, that is, the parts most subjected to strain. In the same way, chronic endocarditis is usually due to increased pressure within the heart, as in chronic Bright's disease, and in conditions that entail prolonged severe strain upon the valves during exertion. A similar cause is at work in pregnancy.

ANATOMICAL CHARACTERS.—Inflammation of the endocardium affects chiefly the valves and the chordæ tendineæ, and especially the lines of contact or the surfaces of the valves exposed to the force of the blood-current. The endocardium of these parts at first appears slightly swollen, velvety, soft, and of various shades of red; whilst the lines or points of contact of the valves present warty enlargements of a similar character, which are known as 'vegetations.' As the process advances, the inflamed areas become more opaque and firm; and a fibrinous deposit is entangled with their surface. When the endocarditis has gone thus far, resolution is probably rare; and the most common result is what is known as 'chronic valvular disease,' that is, that the affected parts are left opaque, puckered, and thickened by growth of connective tissue, whilst the vegetations develop into firm fibroid or even cartilaginous-like bodies. As a consequence of these changes, the valves may become much altered in size and shape, and the ostia contracted and irregular, so that the mutual adaptation of the parts is greatly disturbed. Other results of inflammation are not uncommon in the progress of endocarditis, such as adhesions between the neighbouring structures, and ossification or calcification of the altered tissues. Laceration of the valves and rupture of the chordæ tendineæ during the stage of diminished resistance, ulceration, suppuration, and the formation of aneurysm are rarer events.

The microscopical appearances of inflammation of the endocardium correspond with the naked-eye characters. In the early stages, the proper tissue of the endocardium is swollen by hyperæmia, œdema, and the appearance between its fibres of a number of leucocytes; the latter rapidly multiply to form the bulk of the vegetations; and the surface presents various thicknesses of deposited fibrin, which in its turn may become organised. The further development of connective tissue gives rise to the opacity, thickening, and puckering of the valves, and to the formation of permanent vegetations.

The effects of these changes upon the functions of the valves and their appendages are described in the article Heart, Valves and Orifices of, Diseases of. Particles of fibrin, and even of the vegetations, are occasionally detached from the endocardium, and give rise to embolism.

Symptoms.—The symptoms of endocarditis are inseparable from the symptoms of the disease with which it is associated, and the diagnosis of it is made almost entirely from the presence of physical signs. Thus fever probably precedes the advent of endocarditis in every case; and it cannot be said that the simple uncomplicated disease in any respect affects either the pyrexia or any other element of the same. Local symptoms are almost equally rare, unless the endocarditis leads to serious lesion of the cardiac valves. As long as these remain sound, and the disease is acute and does not involve deeper structures, pain in the heart, præcordial distress, syncope, shortness of breath, and other symptoms of heart-disease cannot be said to occur at all frequently in endocarditis. The cardiac contractions are necessarily increased in frequency; and palpitation and dyspnœa may occur on movement. It is otherwise when the inflammation has lasted so long as to render the valves incompetent, or to obstruct the orifices; or when the myocardium is attacked, and dilatation ensues. The symptoms just enumerated then make their appearance. In children, rheumatic endocarditis is peculiarly latent, and also dangerously progressive or recurrent. *See* Rheumatism, Acute.

Physical Signs.—The physical signs of acute endocarditis are—increased extent and frequency, with variable strength, of the visible and palpable impulse; moderate increase in the area of præcordial dulness; and various alterations in the cardiac sounds. At the beginning of endocarditis, the first sound at the left apex is frequently heard prolonged and hollow, or muffled; and, as the process advances, this alteration of character may gradually pass into a murmur, which is at first indistinct, but afterwards well-formed. If the aortic valves are affected, the second sound may similarly lose its characters, become dull, and finally be converted into, or be complicated with, a murmur. The most frequent murmur in acute endocarditis is mitral systolic; aortic murmurs are decidedly less common; and mitral præsystolic murmur is very rare. Various murmurs, inorganic or organic, may also appear and disappear during the course of the disease.

Complications.—Endocarditis is itself always a complication of the diseases previously mentioned. Myocarditis and pericarditis may be correctly regarded as complications of endocarditis, when the inflammation begins in the lining membrane of the heart. According to some authorities, clots may form in the heart in endocarditis, and give rise to very urgent symptoms (*see* Heart, Thrombosis of). Embolism may arise from detachment of fragments of coagula or vegetations. Congestion or inflammation of the lungs frequently occurs in association with endocarditis, and so may albuminuria.

Course, Terminations, and Sequelæ.—The course of simple endocarditis is very uncertain, and varies with the course of the original disease with which it is associated, as well as with the complications. If acute rheumatism be quickly checked, inflammation of the endocardium will be also arrested; but the two diseases may recur together. In a considerable number of cases, however, endocarditis passes on to chronic valvular disease. The late Dr. Sibson found that seventeen out of seventy cases of endocarditis with mitral systolic murmur ended in established valvular disease, and less than a half of the cases with diastolic basic murmur.

Simple endocarditis very rarely proves fatal, but, being by far the most common cause of valvular disease of the heart, it leads indirectly to much suffering, and in such cases as a rule ultimately to death.

Diagnosis.—The diagnosis of endocarditis depends upon the discovery of the development of an endocardial bruit of organic origin during the course of one of the diseases already named. From functional murmurs the bruits of valvular inflammation may be diagnosed under different circumstances—first, by their locality, which is most frequently the mitral area; secondly, by their time, diastolic or præsystolic murmurs being always organic; and, thirdly, by their association with pericardial friction. The special characters of inorganic murmurs are described elsewhere. Chronic valvular disease may be diagnosed from acute endocarditis by the presence of cardiac enlargement and many well-known signs; of marked cardiac symptoms—especially pain and dyspnœa; of certain lesions—mitral stenosis, for instance, being very rarely an acute lesion; and of visceral complications. Much more difficult of diagnosis is acute endocarditis occurring in the course of chronic valvular disease. Change of the character of the murmur, if this have been previously known, may lead to the suspicion of fresh inflammation but cannot positively establish the diagnosis of its existence. Acute endocarditis is most frequently overlooked when the primary disease is 'latent'—particularly rheumatism in children.

Prognosis.—The immediate prognosis of acute endocarditis is generally favourable, and may be safely estimated by the absence of local symptoms. The remote prognosis, on the other hand, as regards both life and health, is bad, inasmuch as endocarditis so frequently ends in chronic valvular disease. This result is very often difficult or impossible to forecast. A feeble, soft, and smooth murmur, or a feeble and grave murmur, is much more likely to disappear than a loud, extensive, well-defined bruit. The probability of the disappearance of diastolic basic murmurs is very small; it may be best estimated by the absence of the effects produced by aortic incompetence upon the heart and vessels. Murmurs referable to endocarditis disappear more often in young subjects than in adults.

Treatment.—The treatment of acute endocarditis has to be discussed under three heads—namely, first, preventive; secondly, immediate; and, thirdly, subsequent treatment.

(*a*) *Preventive treatment.*—When a patient is suffering from any disease which may become complicated with endocarditis, and especially if he be suffering from acute rheumatism, every means must be adopted to prevent, as far as possible, the occurrence of inflammation of the heart. Thus, in acute rheumatism it is all-important to check at once the intensity of the disease by recourse to one or other of the salicyl compounds or other means; for experience shows that endocarditis, when it does occur in acute rheumatism, generally makes its appearance within the first week. Again, the duration of the primary disease must be curtailed if possible, inasmuch as endocarditis, although it generally appears early, may possibly occur at any period of the disease. Thus the medicinal preventive treatment of endocarditis in these cases resolves itself into the medicinal treatment of acute rheumatism. Another point of equal importance in the prevention of endocarditis is diminution of the cardiac activity. We have seen that the pressure within the heart is an important factor in the causation of endocarditis; and this pressure must be reduced by diminishing the work to be done by the heart, without lowering the cardiac power. Rest must therefore be enforced in the recumbent posture—an end which is usually already secured by the presence of acute rheumatism of the joints. Excitement of every kind has to be strictly interdicted. The personal comfort of the patient must be zealously attended to, and pain relieved, so that restlessness and irritability may be avoided; and for this purpose carefully selected anodynes may be necessary. Stimulants must be cautiously ordered; the bowels regularly and fully moved; and the various secretions kept as active as possible.

(*b*) *Treatment during an attack.*—When endocarditis has actually made its appearance, the various means just insisted upon must be enforced as rigorously as before, so as to diminish the intensity of the inflammation, and to limit the extent of surface involved. Rest is still of the first importance, mental as well as bodily. The medicinal treatment of the original disease—especially of acute rheumatism—must be persevered in. Local applications to the præcordia, such as cataplasms, or leeching, in cases of sthenic inflammation, are often of great service. The administration of stimulants will require the greatest care; excitement of the heart, on the one hand, being avoided, and, on the other hand, digitalis, ammonia, or alcohol being employed if symptoms of cardiac distress supervene. Equal caution is demanded in the use of anodynes which may be indicated to relieve distress connected with the joints; and local applications, such as cotton-wool, poultices, aconite, and belladonna, should be employed in preference to opium, chloral, and other cardiac depressants.

(*c*) *Treatment after an attack.*—When the primary disease, such as rheumatism, has subsided, and the restoration of the various functions indicates that convalescence has commenced, the physician must not forget the state of the endocardium which has recently been inflamed, and which is still in a condition of great physical weakness, and the seat of new cell-growth. Instead of urging the patient to sit up and walk about under these circumstances, as must have been frequently done under the 'rival methods' of treating acute rheumatism, we should recommend a very gradual return to exercise, and the most jealous avoidance of actual exertion. There can be no question that, at this stage, rest for several weeks is of more importance than medicinal treatment. At the same time various tonic and other remedies should be employed.

2. **Ulcerative Endocarditis.**—Synon.: Malignant Endocarditis; Diphtheritic Endocarditis; Fr. *Endocardite Ulcéreuse*; Ger. *Infectiose*, *Maligne Endocarditis.*

Definition.—An acute, subacute, or chronic infective disease, characterised by ulceration of the endocardium or by vegetative growth upon it.

Ætiology.—Ulcerative endocarditis occurs most frequently between the ages of twenty and forty, but is not uncommon in children. More women suffer than men, in consequence of its frequent origin in puerperal disease. Previous valvular disease distinctly predisposes to it.

An exciting cause sometimes cannot be discovered. In most instances, however, ulcerative endocarditis is but part of a general septic or pyæmic process. The common sources of infection are septic wounds, puerperal thrombosis, pylephlebitis, otitis media with thrombosis of the associated sinuses, acute osteomyelitis, gonorrhœa, injuries and ulceration of the urethra and prostate—in connexion, for instance, with stricture and catheterism; also acute pneumonia and pulmonary gangrene, acute rheumatism, and other acute specific diseases. The primary lesion may be so slight as to escape observation.

Anatomical Characters.—Malignant endocarditis, as the name is commonly employed, comprehends a variety of morbid conditions in connexion with the heart. Two of these are fairly distinctive, the *ulcerative* and the *vegetative*, and they may be conveniently selected for description as being the most diverse types between which there lie a number of intermediate forms.

In the *ulcerative* form, the endocardium presents small areas where the proper tissue has disappeared, leaving behind it shallow ragged erosions. This change occurs most frequently in connexion with the mitral valves and opening, including the auricular aspect of the curtains and the line of attachment of the valves—particularly the two commissures of the segments, and the anterior aspect of the anterior segment; also the aortic cusps; parts of the septum and general endocardial surface; and the papillary muscles and chordæ tendineæ. The endocardium of the right ventricle is relatively more frequently involved in malignant than in simple endocarditis.

The earliest stage of the morbid process may sometimes be observed as small yellowish opacities of the endocardium. But as a rule the surface is found already eroded, presenting a small, irregular, oval, circular or linear ulcer; its ragged grey base covered with a loose friable thrombus; its edges fringed with vegetations, swollen, indurated, and undermined. Such an ulcer increases but slowly in area, but it readily advances into the depth of the tissue. A variety of secondary changes may then occur—acute valvular aneurysm, complete perforation of the valves, abundant vegetative or fungating growths, and suppuration, which ends in acute cardiac aneurysm or in complete perforation of the parietes.

The *vegetative* form of malignant endocarditis is readily recognised *post mortem* by a prominent and possibly extensive growth of polypoidal vegetations, in connexion usually with the auriculo-ventricular opening, the neighbouring surface of the left auricle, and the auricular aspect of the mitral segments. Less frequently the aortic valves are involved. In either situation the vegetations form a large mass of soft growth, almost choking the mitral or aortic opening, whilst portions of it must have floated and waved in the blood-current, and by their contact or impact during the cardiac movements have injured the neighbouring or opposed surfaces of the endocardium, there setting up fresh disease of the same kind. The surfaces of these vegetations are sometimes calcified.

In both forms of malignant endocarditis it is obvious that during life portions of the diseased endocardium and thrombi, as well as their fluid products, whether on a small or on a large scale, must have been readily detached or washed off, and carried as emboli into other parts of the circulation.

In addition to the lesions just described, the heart may present a variety of morbid changes. It is in at least 75 per cent. of cases (Sansom) the seat of chronic valvular disease and associated enlargement; sometimes of congenital malformation. The myocardium may be swollen and in a state of granular degeneration like other visceral structures; or it presents a number of small embolic, hæmorrhagic, inflamed, or fattily degenerated areas. Pericarditis is sometimes associated.

Embolism is one of the essential anatomical characters of ulcerative endocarditis. It occurs most often in the spleen, kidneys, and heart, but may be almost universal. In the vegetative form of the disease the emboli may be so large as to be arrested even in the abdominal aorta; the tibial, brachial, and other vessels of the limbs are often occluded, as well as the splenic, renal, mesenteric, cerebral, and a variety of arteries in other parts of the body. In the purely ulcerative type of the disease the emboli are much smaller, and their effects are only recognised *post mortem* by infarcts in various conditions of change. Sometimes these secondary foci proceed to abscess—suppurative meningitis is fairly common. The skin and mucous membranes, the serous membranes, the vessel walls, and the retina are also favourite seats of minute embolism and hæmorrhage. The lungs are specially affected in some cases: pulmonary embolism and infarction accompany ulcerative endocarditis of the right chambers; in other instances acute pneumonia appears to be the primary lesion, in which the endocarditis of the left chambers of the heart has originated. The local effects of infective embolism occur very extensively in ulcerative endocarditis, namely, hæmorrhage, softening, and acute aneurysm ending in fatal rupture. *See* EMBOLISM.

In a considerable proportion of cases of ulcerative endocarditis micro-organisms are found both in the valvular lesion and in the emboli and infarcts. No less than ten different kinds of organisms have been described in this connexion, the chief of these being Staphylococcus pyogenes, aureus and albus; Streptococcus pyogenes; Diplococcus pneumoniæ; and Bacillus tuberculosis.

Micrococci have also been found in the circulating blood. *See* MICRO-ORGANISMS.

SYMPTOMS.—In its clinical characters malignant endocarditis is either (*a*) an *acute*, severe, and fatal malady with markedly typhoidal features; or (*b*) a disease of *subacute*, *possibly chronic*, course, pyæmic in character, occasionally ending in recovery. These two forms call for separate description.

(*a*) **Acute Typhoidal Malignant Endocarditis.**—In this variety of the disease, the patient is seized with a rigor when apparently in good health, or during convalescence from an acute illness—particularly rheumatism; in other instances the invasion is more gradual. Pyrexia and the other phenomena of severe fever are quickly developed, and the patient complains of malaise, debility, and cardiac distress; but for the first two days the medical attendant probably fails to make a complete diagnosis. By the end of this time, the patient's condition having become steadily worse, the cardiac sounds are found to be impure; they shortly become murmurish; and probably on the next day an endocardial murmur is developed, systolic or diastolic, still changeful in its characters. The general symptoms now begin to assume a typhoid type. The patient lies helplessly on his back; the temperature rises to 104°; the tongue, at first furred, becomes dry and brown; sordes form; the respiration becomes hurried, possibly with thoracic pains and hæmorrhagic sputa; and somnolence sets in, broken by low muttering delirium, jactitations and subsultus. The spleen is enlarged and tender, suggesting infarction. The bowels may be relaxed. The skin is visited by heavy sweats, and may become covered with a peculiar petechial eruption. The urine, passed naturally or incontinently, or withdrawn with the catheter, is found to contain blood, albumen, and various micro-organisms. The ophthalmoscope reveals retinal and other intraocular hæmorrhages. Bleeding takes place from the bowel. Less frequent symptoms are parotitis, arthritis, pericarditis, and jaundice. Meningitis, associated with headache and delirium, and ending in coma, is more common, and gives a new or different aspect to the case.

Malignant endocarditis of this severe type may be said to always terminate in death after a duration of less than fourteen days; it has been known to end fatally in two days. The course which the disease pursues is one of steadily increasing gravity, broken only by equally ominous complications in the form of meningitis, hæmorrhages, or sudden paralysis referable to cerebral hæmorrhage. Very rarely the disease passes into the subacute or chronic form.

The pyrexia belongs to the continued type, the maximum rise being 104° or 105° F., with a daily remission of about one degree. In some instances it may not exceed 101°, or even keep close to normal. With the fever may be associated repeated rigors, followed by increased prostration and stupor. The physical signs connected with the heart have already been referred to. The endocardial murmur is usually systolic and mitral. It develops under observation, changes in loudness and quality day by day, and may be reinforced by a second murmur over another part of the præcordia. If traced to the right side of the heart, it is of special significance. Occasionally the murmur is absent, suggesting a parietal lesion. The radial pulse presents all the characters of the typhoid state with increasing prostration, rather than those of any particular form of valvular disease. The so-called skin 'eruption' consists of fine reddish spots, with paler centre representing the seat of a minute embolus. The signs of pleurisy, pulmonary infarction or gangrene, or even of pyo-pneumothorax, are sometimes to be determined.

(*b*) **Subacute and Chronic Malignant Endocarditis.**—This variety of the disease bears but little superficial resemblance in its clinical characters to the severe form just described. Its general features are those of subacute or chronic cardiac disease accompanied with pyrexia and multiple embolism. Heart-disease is the central fact, on which are superadded the phenomena of general infection. There is no prostration until the last; no typhoidal aspect. The patient is anæmic, sallow, poorly, and he wastes steadily; but he sits up in bed, reads, engages in conversation intelligently and cheerfully, and may even resent strict treatment. The physical signs connected with the heart consist mainly of a well-developed endocardial murmur, possibly referable to a previous valvular lesion, but changing its characters from time to time under observation.

It is usually systolic and mitral; occasionally aortic systolic or diastolic, or mitral presystolic; and it may be suddenly altered or complicated by the development of a fresh lesion in the heart, such as rupture or perforation. The pulse varies greatly.

The type of pyrexia in fully developed cases of malignant endocarditis of subacute course is markedly remittent, or even intermittent. Three, four, or even six degrees F. of a rise and fall (between 98° and 102° to 104°) may be recorded daily for weeks on end. In other instances the disturbance of temperature takes the form of irregular bouts of pyrexia complicating the downward course of a severe case of valvular disease. Some patients suffer from repeated rigors, unexpected and irregular, followed by profuse sweats and prostration.

The other phenomena of general infection are mainly significant of embolism: pain and the proper physical signs of infarction of the spleen and lungs, blood in the urine, loss of pulsation in the arteries of the limbs, the development of acute aneurysm with subsequent rupture, and even gangrene of the extremities. This element of the disease gives it a peculiarly uncertain and protean character, its course being, for instance, suddenly interrupted by the development of severe hæmorrhage into the peritoneal cavity, or possibly into the brain, with paralysis and coma ending in rapid death.

The duration of this disease is almost indefinite. It extends from six or eight to twelve or sixteen weeks; in one case of Dr. T. Henry Green's it lasted eighteen months. The progress is very striking. The patient steadily but almost imperceptibly loses strength, flesh, and colour. With very few exceptions, the disease terminates in death, and such patients as have recovered were left with permanent heart-disease.

Pathology.—In the less severe type of ulcerative endocarditis (as in the more familiar ulcers of the integuments) portions of the ill-nourished, degenerated, or lowly organised fibroid tissue of chronic valvular lesions break down in serious impairment of the general health, in acute disease, and in other unfavourable constitutional states (*see* Ulcer and Ulceration). Subjected to constant strain and impact, the ulcerous surfaces extend rather than heal, establish on and around them an increasing growth of vegetations, and these become the source of multiple embolisms. In cases of this kind no morbific micro-organisms are present; the disease runs a comparatively slow course; and recovery may occur. In the acute typhoidal type of the disease it appears that true contagia, derived from some obvious source (the 'primary lesion'), or entering the blood through some unknown channel ('idiopathic'), settle on the endocardium whether previously diseased or injured—possibly even when intact. The organisms flourish on this soil, shed their products into the circulation, and plant embolic colonies of their own kind as multiple foci of disease throughout the body. This process is necessarily associated with a septicæmia of a more or less severe kind, according to the nature of the organisms and emboli. Some authorities deny that the organisms are the essential cause of the morbid process, and it must be acknowledged that the full and complete proof of this connexion is not yet established.

Diagnosis.—Now that malignant endocarditis has been so carefully investigated, its recognition ought not to be attended with much difficulty. The acute form has to be diagnosed from typhoid fever, acute tuberculosis, and other infective diseases belonging to its own type. The diagnosis usually turns on its association with some primary disease, and on the result of a physical examination of the heart and the correct interpretation of any murmur that may be discovered. When no murmur is developed, ulcerative endocarditis may escape recognition. Repeated rigors, the type of pyrexia, the character of the spots, and the occurrence of retinal hæmorrhages will further serve to exclude typhoid fever and tuberculosis. When delirium and other cerebral symptoms are urgent, ulcerative endocarditis has been mistaken for 'cerebral rheumatism' and simple meningitis.

The subacute and chronic forms are specially liable to be confounded with a number of diseases which present a similar type of pyrexia, particularly the many pathological conditions which underlie obscure persistent pyrexia, such as latent tuberculosis; lymphoma; chronic suppuration in connexion with the liver, prostate, bowel, kidney, internal ear, lymphatic glands, and connective tissues; and also syphilis. The existence and changeful character of the murmur, the sudden embolisms, and the absence of other local signs, all indicate the cardiac seat of the disease. From malaria it can be distinguished by the history, by the absence of periodicity in the rigors and fever, as well as by the cardiac murmur.

Some of the gravest complications of this form may, for a moment, be misleading, such as violent headache ending in coma, referable to the development and rupture of embolic intracranial aneurysm. Experience teaches us to be prepared for every possible variety of symptom in a disease of which a striking feature is visceral embolism.

Prognosis.—The prognosis of acute malignant endocarditis is practically hopeless. In the subacute form the prospect is but little better. However confident and cheerful the patient may be at first, the disease will surely, if slowly, exhaust the strength, and may at any period rapidly prove fatal by some complication. If the temperature fall and become less remittent, if the rigors cease, and particularly if weight and strength increase, hope may begin to rise that the case will prove one of the very few exceptions and ultimately recover. But the practitioner must not forget the precarious nature of such improvement, and the incompleteness of the recovery at the best.

TREATMENT.—The failure of every means of cure hitherto employed in acute malignant endocarditis serves to impress on us the importance of preventive treatment. Dr. Sansom urges the necessity of protecting the subjects of chronic valvular lesions against zymotic diseases, and also of attending in them with special care to the treatment of suppuration. When ulceration has commenced, the case must be managed on the general principles applicable to all acute specific fevers, the best possible nursing, abundance of food, and a free supply of stimulants being provided. Fresh air is essential; and if the disease be traced to some error of sanitation, it may be advisable to take the risk involved in changing the room, or even the house, in which the patient is lying.

A great variety of drugs have been tried in both forms of this disease, unhappily with little benefit, including mercurials, quinine and other antipyretics, and the essential oils of eucalyptus, turpentine, and their allies. Two methods are reported to have been attended with success in a few instances of the chronic form: the sulphocarbolates of sodium introduced by Dr. Sansom in 30-grain doses four times a day, and quinine in 15-grain doses three times a day with a free allowance of alcohol (in the form most agreeable to the patient), which is recommended by Professor Fraentzel of Berlin.

II. **Myocarditis.**—SYNON.: Carditis; Fr. *Myocardite*; Ger. *Myocarditis.*

DEFINITION.—Inflammation of the walls of the heart.

This disease may be either acute or chronic; but the latter form, which is attended with the formation of fibroid tissue in the myocardium, is described under the head of HEART, Fibroid Disease of. Pyæmic inflammation of the substance of the heart also constitutes so special a form of disease that it is treated separately (*see* HEART, Pyæmic Abscess of). Acute myocarditis alone, therefore, has to be considered in the present article.

ÆTIOLOGY.—A certain amount of myocarditis is sometimes associated with acute endocarditis and pericarditis, and depends upon the same causes; the most frequent being acute rheumatism. In a small proportion of cases, rheumatic myocarditis appears to occur independently of inflammation of the lining or of the covering membrane. In the great majority of recorded cases of localised myocarditis ending in abscess, the cause of the disease was altogether obscure. It has been observed most frequently in males, and before the twenty-fifth year of life. Exposure to cold, severe exertion, and local injury are mentioned amongst exciting causes, but with questionable correctness.

ANATOMICAL CHARACTERS.—Acute inflammation of the myocardium generally involves the connective tissue as well as the muscular fibres; but in a few instances the latter alone have been found affected, constituting so-called *parenchymatous myocarditis.*

The ordinary form of the disease is characterised by the appearance of leucocytes between the muscular fibres of the heart. In one class of cases, the inflammation is moderate in intensity but *diffused* in extent, affecting one or more layers of muscle underlying the endocardium or the pericardium, which is also inflamed; in another class of cases, the inflammation is more active, and proceeds to the formation of abscess, whilst it is, as a rule, comparatively *localised.*

In the first or diffused form, the myocardium, as it is seen through its inflamed covering, appears of a mottled opaque buffy colour, and is somewhat swollen and softened. The microscopical characters consist chiefly in the appearance of leucocytes and inflammatory effusion in the intermuscular connective tissue; swelling, opacity, nuclear proliferation, and rupture of the muscular fibres, followed by fatty degeneration and atrophy of the same; and the ordinary inflammatory changes of the vessels of the part. Beyond this stage, unless the case prove fatal, the diffused form of myocarditis passes into a chronic condition; and it ends either in fibroid disease with a moderate amount of atrophy, by development of the inflammatory products and compression of the affected fibres; in fatty degeneration; in calcification; or in cardiac aneurysm.

Suppuration of the heart, on the other hand, generally takes the form of swollen yellowish-white patches or abscesses, surrounded by dirty-red or ecchymosed tissue, boggy or pulpy to the finger, and containing on section a small quantity of variously coloured puriform matter, consisting of pus and muscular débris. In the same cases a great part of the walls of the heart may be in a condition of parenchymatous degeneration; and in some recorded instances the whole of the cardiac tissue is described as infiltrated with pus. Abscesses resulting from acute localised myocarditis are generally very small, varying from the size of a pea to that of a nut. They may either burst externally into the pericardial sac, or internally into one of the cavities or through one of the valves, leading to pyæmia, and to the formation of an acute cardiac aneurysm; or the pus may make its way both externally and internally, and lead to fatal hæmorrhage into the pericardium. In other cases the pus undergoes the usual changes, and becomes inspissated or cheesy; or calcification takes place.

In both forms of interstitial myocarditis the left ventricle is most frequently the seat of inflammation.

Symptoms.—The principal symptoms of acute rheumatic myocarditis are restlessness and urgent dyspnœa; severe pain and distress referred to the præcordia; and palpitation, which gradually passes into irregularity and greatly increased frequency, and finally into complete cardiac failure. The pulse corresponds. The countenance is anxious, and either pale or cyanosed. The mind is fearful and distressed at first; and delirium frequently supervenes before death, especially in young subjects. Vomiting is not uncommon.

The *physical signs* are generally associated with those of endo- and peri-carditis. When uncomplicated, they may be described as consisting of violent cardiac impulse at first, which rapidly loses in strength and regularity while it increases in frequency; a somewhat increased area of cardiac dulness; and short sharp sounds, afterwards becoming duller and more feeble.

When these symptoms and signs make their appearance, they generally run their course rapidly, and end in death. In a small number of cases they as rapidly disappear.

The symptoms of localised suppurative myocarditis leading to abscess are not unlike those just recorded. There are the same distressing symptoms locally, with restlessness and anxiety, passing on to delirium and ending in collapse. Rigors have been observed in some cases; and a peculiar pustular eruption on the skin in other cases. The physical signs also are not special; excepting that a murmur may be suddenly developed by rupture or perforation of part of the wall or of a valve.

The majority of cases of abscess of the heart prove fatal by asthenia; but the other terminations of abscess mentioned above will be attended by their respective symptoms, and the possibility of sudden death is especially to be noted.

Diffuse *parenchymatous* myocarditis is clinically known only as a cause of sudden death.

Complications. — The complications of acute myocarditis have already been sufficiently indicated, such as, first, ætiologically, pericarditis, endocarditis, acute rheumatism, and other causes of these forms of inflammation; and secondly, pathologically, rupture of the cardiac walls or valves, acute cardiac aneurysm, hæmato-pericardium, embolism, and septicæmia.

Course and Terminations.—The course of acute interstitial myocarditis, as already stated, is generally rapid, extending from a few hours to eight days in different cases. Death occurs, in the great majority of cases, from the effects of cardiac failure, if the inflammation be extensive or proceed to suppuration. The formation of acute aneurysm by internal rupture, the production of pericarditis by external rupture, and other complications will variously modify the progress and termination of cardiac abscess. Simultaneous rupture both externally and internally causes sudden death.

Diagnosis.—The diagnosis of acute myocarditis is extremely difficult. Occurring in connexion with acute rheumatism, it has to be distinguished from endo- and peri-carditis. The absence of murmur and of the characteristic signs of pericarditis, along with symptoms of cardiac failure and severe local phenomena, such as pain, distress, dyspnœa, and finally collapse, should generally serve to establish the diagnosis of inflammation of the walls of the heart. It cannot be said that cardiac abscess has ever yet been diagnosed; but the careful consideration of all the points in the case, including the sudden development of a murmur indicative of rupture of a portion of the wall, or of a valve, may hereafter ensure greater success. In the event of the development of the last-named sign, and of septicæmia or embolism, cardiac suppuration would have to be carefully diagnosed from ulcerative endocarditis. In children, the delirium of acute myocarditis has to be distinguished from acute meningeal inflammation, an object which may be effected by the careful observation of the signs and symptoms connected with the heart.

Prognosis.—The prognosis of myocarditis, when it is either so extensive or so intense as to give rise to unequivocal symptoms, is extremely unfavourable.

Treatment.—The two principal indications of treatment in acute inflammation of the substance of the heart are to rest and sustain that organ, and to relieve the pain and distress. Local anodynes, especially in the form of the preparations of belladonna and poultices; and stimulating 'counter-irritants,' such as mustard cataplasms, will conduce to fulfil the second indication. Such relief is the first essential, if rest is to be secured. The patient must be spared the very smallest exertion. Food must be given in small quantities, and be easily digestible and highly nutritious; the bowels must be kept open; and the flow of urine should be as free as possible. Alcoholic stimulants will be urgently called for, but must be employed with great discrimination; and palpitation, as much as weakness of the impulse, is to be regarded as an indication of the necessity for these. At the same time, digitalis, ammonia, and other cardiac stimulants should be given cautiously, so as to sustain the cardiac action.

J. Mitchell Bruce

HEART, Malformations of.—Synon.: Fr. *Affections Congénitales du Cœur*; Ger. *Missbildungen des Herzens.*

Classification and Description.—The cardiac anomalies of development may be classed as follows:—

I. Those dependent on arrest of the process of development at an *early period of fœtal life*, so that the organ retains its most rudimentary form, the auricular and ventricular cavities being still single or presenting only slight indications of division, and the primitive arterial trunk being retained, or the aorta and pulmonary artery being very imperfectly evolved.

II. Those in which the defective conformation occurs at a *more advanced period*, when the auricular and ventricular partitions are already partly formed, and the aorta and pulmonary artery more or less completely developed. Such are the cases in which, with imperfect separation of the ventricles and auricles, the arterial or auriculo-ventricular passages are constricted or obliterated, and the origins of the aorta and pulmonary artery are misplaced.

III. Cases in which the development of the organ has progressed regularly till the *later periods of fœtal life*, so that the auricular and ventricular septa are complete, and the primary vessels have their natural connexions, but in which there are defects which prevent the heart undergoing the changes which should ensue after birth. Such are the premature closure of the foramen ovale, the non-development of the ductus arteriosus, and the occurrence of slighter sources of obstruction at the arterial or auriculo-ventricular passages or in the course of the aorta.

IV. Cases in which there is some irregularity in the formation of the valves, or in the connexions with the vessels, or in the vessels themselves, which, though not immediate sources of obstruction, *may become so during the progress of life*, so as to lay the foundations of subsequent disease.

I. Cases of the first class are of very infrequent occurrence, and are the more rare according to the extent of the imperfection. The first case of simply biloculate heart was placed on record by Mr. Wilson, in the *Philosophical Transactions*, in 1788, and the specimen is preserved in Dr. Baillie's museum, in the possession of the Royal College of Physicians. The anomaly was found in the body of a child, which survived for seven days. From defect in the diaphragm, the heart lay in a sac on the upper surface of the liver; and the organ was found to consist of an undivided auricle and ventricle, and a single artery, evidently the primitive arterial trunk, which first gave off a vessel that furnished the branches to the lungs, and the vessels to the head and upper extremities. The coronary arteries arose by a common trunk from the aorta before its final division. Since the publication of this case, others have been placed on record, illustrating the gradual advancement from the simple to the more complicated forms—the ventricle becoming more completely divided, the septum of the ventricles being more fully developed, and there being two vessels given off from the ventricle, though in some cases one of these may be abortive, or if there be only a single vessel, that being shown by the origin of the coronary arteries from its commencement to be really the aorta.

II. Of the second class, the examples which have been described are much more numerous. In cases of this kind the auricles and ventricles are fully formed, though the septa which divide them are incomplete, and there is usually more or less displacement of the origins of the primary vessels, so that the aorta more especially may come to arise partly or almost entirely from the right ventricle; or the points of origin of the vessels may be transposed, the aorta arising from the right ventricle, and the pulmonary artery from the left. Cases of the former description, in which the septum of the ventricles is incomplete, and the aorta misplaced to the right, are almost always found to coexist with some obstruction to the passage of the blood from the right ventricle, either (1) from smallness of the pulmonary artery; (2) from imperfection of the valves; (3) from constriction at the outlet of the right ventricle, or at the end of the conus arteriosus or infundibular portion of the ventricle; or (4) from constriction at the commencement of the conus or point of union between that portion of the ventricle and the sinus. A case of the second description was published by Sandifort, in 1777, and one occurred to Dr. Hunter in 1761, but was not published till 1763. The fourth form of obstruction, or that occasioned by constriction between the sinus and the infundibular portion of the right ventricle, has only recently been explained, though cases of the kind have for some years been placed on record. It is indeed probable that the existence of a very decided partition in this situation led to the idea entertained by some of the older pathologists, that the heart occasionally had three ventricular cavities. The abnormal septum is partly formed by hypertrophy of the muscular structure, and partly by the endocardium becoming thickened; and in some cases very decided obstruction is so caused. The defect is generally developed at an early period of fœtal life. The septum of the ventricles is therefore incomplete, the defect being at the posterior part, so that the aorta comes to arise from the sinus of the right ventricle, while the pulmonary artery takes its origin from the infundibular portion, which seems to constitute a distinct cavity. The heart thus, as pointed out by Mr. Grainger, bears an almost exact resemblance to the condition of the organ in the turtle. In the turtle there are two aortic ventricles and one pulmonic ventricle; the right aortic and the pulmonic ventricle being the analogues of the sinus and infundibular portion of the right ventricle, and being in connexion, while the left aortic ventricle is distinct.

Much more rarely there has been found an entire obliteration of the orifice or trunk of the pulmonary artery, the first case of this description of anomaly having also been published by Dr. Hunter at the same time as the former case. Much more rarely, also, the defect in the ventricle has been found in connexion with obstruction or obliteration of the right auriculo-ventricular, the left auriculo-ventricular, or the aortic aperture. Where the septum of the ventricles is incomplete, the defect generally exists at the base, at the part which has been termed the *undefended space*—the space which intervenes between the contiguous sides of the left and posterior semilunar segments, where on the left side the muscle is naturally deficient; and in this way a connexion may exist between the left ventricle and right auricle or ventricle, either immediately above or below the right auriculo-ventricular opening. More rarely the septum between the left ventricle and the conus arteriosus of the right ventricle is defective; and still more rarely an aperture exists at a lower part of the septum. The portion of the septum dividing the left ventricle from the sinus of the right is termed by Rokitansky the posterior—that between the left ventricle and conus arteriosus, the anterior septum. With the defects now mentioned, the auricular septum may also be incomplete, or the foramen ovale may be still open, or the ductus arteriosus pervious. Indeed, when the pulmonary artery is much contracted or impervious, one or other of the former conditions necessarily exists, and the ductus arteriosus becomes the means by which the blood is conveyed to the lungs, though occasionally there are compensatory branches derived from the aorta or one of the large vessels also distributed to the lungs.

The transposition of the aorta and pulmonary artery also occurs at an early period of fœtal life. The first case of the kind recorded was related by Dr. Baillie in 1797; the specimen is figured in his plates, and still exists in the museum in the possession of the Royal College of Physicians. In this anomaly the septum of the ventricles is generally defective, and the two fœtal passages open, and the organ may indeed be very defective in conformation. The heart also is often misplaced in the chest. Another form of defect is that in which the descending aorta is given off from the pulmonary artery through the ductus arteriosus. This condition is apparently the result of imperfect development of the isthmus aortæ between the origin of the left subclavian artery and the point of entrance of the duct, so that an adequate supply of blood cannot be conveyed from the ascending into the descending aorta. Generally the condition coexists with defect of the septum of the ventricles, as in two cases formerly in the possession of Sir Astley Cooper, and now contained in the museum of St. Thomas's Hospital, described by Dr. Farre in 1814. In some instances of this kind the portion of aorta between the left subclavian artery and the duct is imperforate, and yet in others, as in a case related by Steidelle and referred to by Hein in 1816, there is no connexion between the two portions of the aorta, the ascending part giving off the vessels to the head and upper extremities, the descending portion being wholly derived from the pulmonary artery. This form of defect is closely allied to the cases which are occasionally seen in after-life, in which there is constriction or obliteration of the isthmus aortæ beyond the left subclavian artery, the circulation being maintained through collateral channels.

III. The third class of cases consists in the premature closure of the foramen ovale; or the non-development or disappearance, at an early period of fœtal life, of the ductus arteriosus; or in diseased conditions of the valves, which prevent the heart undergoing the changes which should ensue after birth.

The first condition is of very rare occurrence. The first instance recorded was related by Vieussens in 1715. In these cases, the blood during fœtal life being all transmitted through the right cavities and the pulmonary artery and duct, those portions of the heart are unduly developed, while the left side of the organ becomes atrophied. In the second class of cases the heart is defectively developed, and the right ventricle gives origin to the aorta, and often also vessels are distributed from the aorta to the lungs, while the ordinary pulmonary artery may be very small in size, or may be entirely absent. In a case of this kind, described by Dr. Ramsbotham, the pulmonary artery is said not to exist; but by examination of the specimen preserved in the London Hospital Museum, the writer has ascertained that this is not correct. The artery exists as a very small vessel, but the scanty supply of blood to the lungs which it furnished was complemented by small vessels from the aorta. In cases which are not of uncommon occurrence, and may be classified with the malformations now spoken of, but which are closely allied to the next class, there exists some source of obstruction to the transmission of the blood from or into the right ventricle, which determines the imperfect closure of the foramen ovale, or the patency of the ductus arteriosus. The obstruction in these cases generally depends on disease of the pulmonic valves, or obstruction at the end or beginning of the conus arteriosus, or at the right auriculo-ventricular aperture.

IV. The fourth class of malformations consists of defects, of a slighter description, of the valves, or narrowing of the orifices or of the isthmus aortæ.

The semilunar valves may be excessive or defective in number. The former condition probably does not materially interfere with the functions of the heart—the latter often does so, and especially when, as is very frequently the case, the valves become the seat of disease in after-life. If there be only two valves, one of them imperfectly representing two distinct segments, there is great liability to incompetence. If there be only one valve, representing three imperfect segments, obstruction is almost necessarily occasioned.

It is probable that the cases in which the tricuspid valve is found represented by a kind of membranous diaphragm, stretched across the orifice and perforated in the centre, and some of the so-called cases of button-hole mitral, are also of congenital origin.

It is not considered necessary in this article to refer to many examples of these different forms of malformation, or to allude to other of the less important deviations from the natural conformation of the heart. The subject will be found more fully treated of in the works of Dr. Farre,[1] of Gintrac,[2] of Freidberg,[3] in the papers of Dr. Chevers,[4] and in the writer's own work.[5] The more recently published cases also are abstracted in the treatise of Taruffi,[6] and numerous examples of different forms of malformation are given by Rokitansky.[7]

Mode of Formation.—It is probable that all the different forms of irregularity in the development of the heart are due to arrest of development, occurring at different periods of evolution, so that the heart retains the forms proper to it at such stages. The cause to which this arrest is to be ascribed can rarely, however, be traced in cases where the defect is great, such as those of biloculate heart, or where the vessels are transposed with or without very marked imperfection in the organ itself. These defects must be ascribed to the imperfect evolution of the double set of cavities, and of the pulmonary artery and aorta from the primitive trunk and branchial arches. In the less marked defects, however, the irregularity can often be traced to a source of obstruction to the transmission of the blood through one or other of the apertures or vessels. Such obstruction is much the most common in connexion with the right ventricle and pulmonary artery. In cases of this kind the septum of the ventricles is deficient, so that the aorta arises wholly or in part from the right ventricle. Dr. Hunter, in the paper before referred to, when describing a case of obstruction of the pulmonic orifice with defect in the septum of the ventricles, suggested that the imperfection in the septum was probably caused by the pulmonic obstruction. Meckel, however, adopted the view that the primary defect was in the septum of the ventricles, and that the pulmonary artery became more or less abortive from being thrown out of the course of the circulation by the ready outlet afforded for the blood from the right ventricle into the aorta. The former view seems, however, to afford the more satisfactory explanation, and is in accordance with the almost constant occurrence of disease of the valves in these cases. According to the view of Meckel, the pulmonary artery should simply be small, as when the ductus arteriosus is absent, like the case of Dr. Ramsbotham's before referred to, but such a condition is very rarely found. The excess in the number of the semilunar valves might seem to afford an example of redundant development, but this condition also probably depends on arrest of development; though, as we do not clearly understand the mode in which these valves are developed, it is impossible to express a very decided opinion as to the cause of the apparent excess.

Symptoms and Diagnosis.—There cannot generally be much difficulty in recognising a case of malformation of the heart during life. Not only in cases of a very marked kind is there generally a complete history of the condition of the subject during its short life, but the symptoms are also very characteristic. The child is very markedly cyanotic; the cheeks, lips, hands, and feet are excessively livid; the fingers and toes are clubbed; the nails are incurved; and the patient is liable on any excitement, or on exposure to cold, to attacks of dyspnœa, often followed by convulsions. There are also often present difficulty of breathing, cough, and expectoration of blood; with cardiac palpitation, and pulsation of the vessels of the neck. If also there be any obstruction at or near the pulmonary orifice, there will be a harsh systolic murmur heard in the course of the pulmonary artery; and if there be a defect in the septum of the ventricles, the murmur will be heard probably also in the course of the aorta. Often there are unhealthy ulcerations about the fingers, toes, and anus or vulva. If the case do not attract notice till later in life, there will probably be less marked signs of obstruction to the circulation, and possibly they may be entirely absent, and there may be no history of the patient's previous condition. In cases of this kind the probability will be that if there is a murmur at the pulmonary artery there is some defect at or near the orifice of that vessel, with or without an aperture in the septum of the ventricles or an open state of the ductus arteriosus. The former condition is so rare as the result of disease in after-life, that if the signs point to pulmonic valvular disease, its congenital origin may safely be surmised. The open foramen ovale and ductus arteriosus could probably not be diagnosed with any certainty, though cases have occurred in which peculiar murmurs noticed during life were believed to be so produced. It might be supposed that when so small a proportion of the blood is subjected to the influence of the air as in some of these cases, the temperature of the patient would not reach the natural standard; but the most careful observation of the temperature of children labouring under congenital cardiac cyanosis has generally failed to detect any marked difference in this respect between them and other children of about the same age.

---

[1] *On Malformations of the Human Heart.* London, 1814.

[2] *Observations et Recherches sur la Cyanose, ou Maladie Bleue.* Paris, 1824.

[3] *Die angebornen Krankheiten des Herzens, etc.* Leipzig, 1844.

[4] *Collection of facts illustrative of Morbid Conditions of the Pulmonary Artery.* London, 1851, and *Medical Gazette*, 1845 to 1851.

[5] *Malformations of the Human Heart.* Second edition, 1866.

[6] *Sulle Malattie congenite, etc., del Cuore.* Bologna, 1875.

[7] *Die Defecte der Scheidewände des Herzens.* Wien, 1875.

Cyanosis.—There are few subjects which have excited more discussion than the causes of cyanosis or *morbus cæruleus.* Morgagni, in 1761, when describing the case of a girl who had obstruction at the orifice of the pulmonary artery with an unclosed foramen ovale, expressed the opinion that the general congestion was probably the cause of the remarkable lividity which had been noticed during life; and Dr. Hunter, in 1783, in describing a case of pulmonic obstruction with imperfection in the septum of the ventricles, ascribed the lividity to the intermixture of the venous and arterial currents of blood. These two views have since received support from various writers. The view of Morgagni has been maintained by Louis, and that of Hunter by Gintrac. It has been very fully shown that there is no just and constant relation between the intensity of the cyanosis and the amount of intermixture, and indeed that very marked cyanosis may exist without any intermixture; while on the other hand in all cases of marked cyanosis there are present causes capable of producing great venous congestion. The writer is, therefore, of opinion that the evidence is very greatly in favour of the correctness of the views of Morgagni and Louis, that the cyanosis results from stasis of the blood, though probably other causes conduce to the intensity and peculiarity of discoloration. Thus, probably, the defect must be congenital, or, at least, of very long duration, so that the smaller vessels may become greatly dilated; the integuments must be thin, so as to allow the colour of the blood more readily to be seen; and lastly—probably also from the very small portion of the blood which can be subjected to the influence of the air—the whole mass of the blood is of an unusually dark colour, and so the intensity of the lividity is increased.

Duration and Terminations.—The duration of life in the subjects of the different forms of malformation varies greatly, according to the degree of the defect in the heart. In cases in which the organ presents a very rudimentary condition, life can only be prolonged for a few hours or days; while in the slighter forms of defect the patient may survive to puberty or to manhood or womanhood, or even to more advanced age. Thus, in cases of contraction of the pulmonary artery, without other defect in the organ, cases are on record in which patients lived to 44 and 63; when, with the pulmonic disease, the foramen ovale was unclosed, the subjects have reached 40 and 57. Where the septum of the ventricles was deficient, a few patients are stated to have lived to between 20 and 30. Where the ductus arteriosus was still open, patients lived to 13½ and 19 years; but of course these ages are the extremes, and by far the largest proportion of the subjects die much younger. When the pulmonic orifice or artery is impervious, but few patients survive for more than two years, but cases are on record in which 9 and 12 years of age were attained; the age being greater according to the facility afforded for the transmission of the blood from the right side of the heart, as when the septum of the ventricles was imperfect, than when the ventricles were completely separated by a fully developed septum.

Transposition of the aorta and pulmonary artery is a defect incompatible in any of its forms with the prolongation of life for any lengthened period. Four cases are, however, on record in which the patient survived to between 2 and 3 years of age—the imperfection of the septum of the ventricles tending in these cases also to the prolongation of life.

The most common causes of death in cases of malformation of the heart are affections of the brain and lungs, hæmoptysis, &c.; and, if the patient survive for a sufficient period, tuberculous affections. Notwithstanding the very great obstruction to the circulation, dropsical symptoms do not generally arise to any marked degree.

Treatment.—It is scarcely necessary to speak of the treatment of these cases. It must consist in protection against cold; in the maintenance of bodily and mental quiet; and in the use of a nutritious and easily digestible diet. Their special liability to tuberculosis must not be forgotten.

T. B. Peacock.

HEART, Morbid Growths in.—The various forms of morbid growth that have been met with in the heart may be thus enumerated in the order of their frequency: (1) Malignant disease; (2) Lymphomatous or lymphadenomatous growths; (3) Non-malignant tumours; and (4) Cysts. Fibroid growths, syphilitic gummata, and tubercle, as well as hydatids affecting the heart, are discussed separately under their respective heads. Calcareous, cartilaginous, and osseous changes of the myocardium are noticed in the article HEART, Degenerations of.

1. Malignant Disease of the Heart.—Cancer, although the most common of the new formations found in the heart, is still very rare in this situation, and is a subject chiefly of pathological interest.

ÆTIOLOGY.—Malignant disease of the heart is, with very few exceptions, always secondary; and the primary growth may have its seat in any part whatever of the body. Occasionally the heart becomes involved by continuity, the lungs and mediastinum being the seat of the primary disease. Cases have occurred at all periods of life, from infancy to old age; but at least one-half of the subjects have been in the middle period of life. The disease has been most frequently found in males.

ANATOMICAL CHARACTERS.—Carcinoma, epithelioma, and sarcoma, including colloid cancer and melanosis, have all been found in the heart in different instances. Any part of the organ may be affected, and the right side appears to be more frequently invaded than the left; but the disease is generally multiple. The morbid growth usually presents itself upon either of the surfaces of the heart, rather than in the substance of the myocardium. In these situations there may appear one or more masses of malignant disease, which as a rule are easily distinguished from the cardiac tissue around, and which possess the ordinary characters of such formations, according to their respective kinds, encephaloid being the most common, and epithelioma by far the most rare. Any difficulty in the recognition of the disease is removed by section and microscopical examination. The extent of cardiac wall involved by the growth is sometimes great. When the masses of malignant disease project externally, they are frequently associated with pericarditis, either local or general. Prominent nodules in the interior of the heart may cause local endocarditis; and in other instances the valves and their appendages may be so involved that incompetence results. In very rare cases malignant disease of the heart proceeds to ulceration.

SYMPTOMS.—Of thirty-six cases of malignant disease of the heart, the histories of which were collected by Sir Richard Quain (*Lumleian Lectures*), in thirty no symptoms were present, or they were not recorded. In one of the remaining six cases, the subject of the disease—a man of thirty-seven, in whose heart a single large mass of encephaloid cancer was found *post mortem*—had been subject to attacks of excruciating pain in the præcordial region, dyspnœa, palpitation, and vomiting; and death occurred suddenly. Pain in the chest and oppression, not referable to other causes, are recorded in two other cases; in the fourth case there were anginal seizures. In cancer of the heart spreading from the mediastinum or lungs, dyspnœa, cough, and pain are necessarily frequent symptoms.

With respect to the physical signs of malignant disease of the heart, tenderness on percussion over the præcordia (in association with local pain), pericardial friction and endocardial murmurs due to involvement of the valvular apparatus in the new-growth, appear to be the only phenomena that have been specially observed.

COURSE.—The disease naturally ends in death; and in more than one instance this termination was sudden, and perhaps directly due to the affection of the heart.

DIAGNOSIS.—This condition has probably never been diagnosed during life. The appearance of true cardiac pain, or of any of the physical signs just mentioned, in the course of a case of cancer, would, however, be strong evidence that the heart was secondarily involved.

TREATMENT.—The treatment of malignant disease of the heart is necessarily limited to the relief of any symptoms that may be present, and does not differ from the treatment of cardiac distress from other causes.

2. Lymphoma of the Heart.—Lymphomatous or lymphadenomatous growths have been met with in the heart in several cases in which the disease was general, but this affection of the organ cannot be said to have any clinical importance.

3. Non-Malignant Tumours of the Heart.—These growths are also of purely pathological interest, and are amongst the very rarest of morbid appearances in connexion with the heart. *Myomata* have been recorded as instances of this class of diseases. *Lipomata* lying under the endocardium are referred to in the article HEART. Fatty Growth on.

4. Cysts of the Heart.—The occurrence of true cysts in the myocardium (hydatids, abscesses, hæmatomata, and softening gummata being excluded) is doubtful.

J. MITCHELL BRUCE.

HEART, Palpitation of.—SYNON.: Fr. *Palpitation du Cœur*; Ger. *Herzklopfen.*

DEFINITION.—Abnormal movement of the heart, without appreciable structural lesion; the movement, frequent or tumultuous, varying in tone and force.

Ætiology.—The *immediate* or proximate cause of palpitation is an over-stimulation of the excitability of the muscular structure of the heart, induced by functional errors of the cardiac ganglia and of the vagus, more especially the depressor nerve proceeding from its trunk, or of those other nerves which, proceeding from the ganglia of the great sympathetic, supply the heart; it being borne in mind that the cardiac centre in the medulla is subject to impressions co-existent with the whole nervous system, and that these are transmitted by the vagus or sympathetic to the heart. It is therefore a true neurosis. The disordered action of these nerves may be induced either directly by dynamic or adynamic causes, or by reflex action; but in either case the phenomena as regards the heart are the same—namely, the morbid activity or irregularity in a normal function, and which must be here considered as independent of any accompanying organic lesion. In dynamic and reflex palpitation the general blood pressure thus resulting is influenced, partly by peripheral resistance, but mainly by the tumultuous increase in the heart's action. The lessened duration of the diastole adversely determines, first, the period of rest; secondly, the recruiting of the nerve-power of the heart, by lessening the nourishment afforded to its general structure through the coronaries; and, thirdly, the stimulus afforded, by a deficiency in the due amount of blood supplied to the ventricles. As the variableness of this duration is measured by the recurrence of the systole (defined and uniform as regards time), the relative frequency, force, and tone of the pulse-stroke become important elements in the appreciation of these forms of functional disturbance. In the adynamic form the palpitation is mainly influenced by an increase in the peripheral resistance effected by morbid action of the vaso-motor system, and evidenced by a marked deficiency of tone and force in the beat.

The *predisposing* and *exciting* causes of palpitation of the heart are various. The chief *predisposing* causes are to be found in the nervous and excitable temperaments; general debility; inanition; physical depression; exhaustion, whether bodily or mental; early age; hysteria; venereal excesses; and in deterioration of the blood, as occurs in gout, scurvy, chlorosis, or spanæmia. Amongst the *exciting* causes may be classed violent exercise; mental shock, emotion, and all forms of sudden excitement of the nervous system; exposure to too low a temperature; dissipation; injurious articles of diet; and dyspepsia.

Symptoms.—In the dynamic and reflex forms of simple palpitation there may occur (1) a single action; or (2) a series of actions, which may become prolonged, and of such a character as to be esteemed chronic. The single abnormal beat not infrequently occurs during a first sleep, and the patient is wakened by a consciousness of it. Sleep may then return, and the attack subside without other inconvenience; or it may be associated with a feeling of weight, fulness, anxiety, sinking, or even pain of the præcordia. More frequently, however, the attacks are prolonged and recurrent, returning with an accelerated and uncertain frequency. To the patient the act of palpitation causes various and widely different sensations. There may be a mere occasional flutter, or a slightly increased action continuing for a time; or there may be increased action attended with great rapidity, and such violence, that the heart appears forcibly to strike the chest-walls, diffusing its influence over the whole sternal region, and even at times agitating the whole body (a phenomenon probably due to an associated general nervous agitation); or the heart, again, may seem to the sufferer to rise, as it were, into the throat. With these several symptoms there may be the accompanying disturbances of choking—the *globus hystericus*; vertigo; tinnitus aurium; impaired vision, with a feeling of distension of the eyeballs; a copious secretion of pale limpid urine; a clammy coldness of the extremities; fear of death; partial unconsciousness; or actual syncope. These attacks may be preceded by a somewhat prolonged state of cerebral disturbance, as evidenced by heat of brow and vertex, headache, and an inaptitude to think or regulate the thoughts; and as there is generally a self-consciousness of the abnormal action of the heart, the anxiety on this account serves to impress the mind with so much fear and inquietude as to tend to increase and prolong the disorder that has induced them. In the adynamic form there is usually increased frequency with failure of systolic power, so that the pulse becomes deficient in tone, force, and rhythm, and may be even reduced to a mere flutter. The patient is painfully sensible of the disturbance, which induces a feeling of restless anxiety; relief is sought, but not easily obtained, either by moving about or in repose. When this adynamic form of palpitation has its causation primarily from undue depression of temperature, in the peripheral circulation and subsequently in the venous system and right heart, these symptoms become more urgent—may be to the extinction of life; the vaso-dilators of the arteries are paralysed; the systemic current fails, and hence the cerebral vessels and the nutrient vessels of the heart itself are unfilled, the immediate result being syncope and death. This is probably the frequent course of events in drowning. It is certainly so in those cases of death from the injudicious use of the cold bath, taken when physical exhaustion or other circumstances interfere with the necessary reaction from the shock.

Physical Signs.—The physical examination of the heart in the dynamic and reflex forms of simple palpitation, shows the apex-beat to be normal in position, but diffused and much exaggerated in force. The area of dulness, as a rule, is not enlarged upwards, but it may be temporarily enlarged, under certain circumstances, towards the right side. The sounds, always exaggerated, at times become very much so, and usually with a sharp metallic ring. Occasionally a kind of remitting humming sound is superadded, and may be heard even by the patient; but this is never constant. Sometimes the sounds are heard over a great extent of surface; but this extent is no measure of their intensity, for they may not be loud, but abnormally clear and distinct only. Occasionally there is a pericardial rubbing accompanying the mitral apex-shock, simulating the friction-sound of pericarditis; but there is never true friction-sound. The basic second sound, more frequently than the first, presents the metallic ring. Sometimes it becomes lower-pitched and less clicking than in an ordinary attack of palpitation; and may even, as also the first sound, so lose sharpness and abruptness as to assume somewhat of the character of a soft murmur. The aorta, carotids, and large arteries also throb, and have an excited impulse. The smaller arteries are not sensibly affected. The pulse at the wrist is thus often an uncertain indicator of the amount of action exhibited by the heart. Sometimes it has the character of being sharp and jerking, without force; or, should the right side of the heart become loaded with blood, it may be small and soft, and weak. This is markedly the case in the adynamic form; the impulse may be weak even to extinction, and the sounds so feeble as scarcely to be appreciable, while there are indications of a loaded state of the right heart. The symptoms may be summed up as indicative of depressed irritability, even to suppression, with venous congestion. On the subsidence of an attack, the ventricular impulse may return to its natural force and frequency, and the sounds be unaccompanied by any exaggerations. Nevertheless, though the attack may have subsided, there may be slight irregularity of the heart's action perceptible for some short time afterwards.

Diagnosis.—Though the diagnosis of palpitation of the heart in some cases may present difficulty, yet, in the absence of evidence of structural lesion, an increased impulse presenting the above distinctive characters may be assumed to be functional in its origin, and not dependent on any organic disease of the heart itself. We have, in fact, to do with an exaggeration, sometimes highly marked, of the natural nervous susceptibilities of the heart; and this nervous increase of impulse, even when only slight, is usually more appreciated by the patient, more painful, and more a source of anxiety than is that attending organic disease, especially in its earliest stages.

Treatment.—Palpitation, in reference to treatment, may be briefly viewed as dynamic, reflex, and adynamic. Reflex palpitation, as irritative in its centripetal origin, is, for the most part, dynamic in character; and therefore its occurrence with the dynamic forms is to be temporarily met by corresponding remedial agents. Those sedatives which combine sedation with diffusible stimulation are in practice very generally selected, because a rapidly acting heart is not necessarily distributing the blood evenly through the vessels; in fact, the pulse may be no guide to the action of the heart, this being influenced by other causes. These remedies include ether, camphor dissolved in spirit of nitrous ether, ethereal tincture of lobelia, and bromide of ammonium, sedatives combined with ammonia, and carminative volatile oils. The rational treatment, however, even during the attack, is rather to strengthen those measures which before and after are to be used to counteract the cause, and to lessen vascular tension, as well as to quell inordinate cardiac action. Aconite, diluted hydrocyanic acid, or the green hellebore, are therefore especially indicated; or the inhibitory action of digitalis and its allies may be called for. In adynamic palpitation the sedative action is not required, but stimulation, either through the nerves or upon the heart itself, is mainly to be relied on. Thus, sumbul, castor, valerian, or alcohol, and ammonia, or compound tincture of lavender, and allied medicines may temporarily relieve the attack. Of all stimulants to an enfeebled and impeded circulation and adynamic inordinately acting heart, nitroglycerine or trinitrin is the most reliable and most powerful; and the allied remedies are to be found in amyl nitrite and the alkaline nitrites. It is important, however, to observe that the action must be maintained in a properly regulated dose, for this should not involve any depressing influence on the nervous system, as cannot generally be avoided when amyl nitrite is given by inhalation; and the dose of trinitrin cannot be measured by a fixed standard of one minim of a 1 per cent. alcoholic solution, for in some cases half the standard dose will be sufficient; in other cases double the amount will be required to produce the requisite degree of stimulant action. T. Shapter.

HEART, Pyæmic Abscess of.—Definition.—Abscess of the heart occurring in pyæmia.

Ætiology.—Abscess of the heart has been most frequently observed in cases of pyæmia following acute necrosis of bone or diffuse periostitis; less frequently after phlebitis, chronic or acute arthritis, urethral stricture, chronic abscess, and cancerous ulceration.

In eleven out of fourteen cases, the histories of which were collected by Sir Richard Quain (*Lumleian Lectures*), the age of the patients was seventeen years or under; and twelve out of the same fourteen cases were males. In other words, pyæmic abscess of the heart has been most frequently found in cases following injury to a bone or to a joint in boys. In older subjects it has been associated with pyæmia secondary to one or other of the diseases just mentioned. In a few cases no primary disease was discovered.

Anatomical Characters.—Pyæmic disease of the walls of the heart most commonly affects the left ventricle—towards the base and in the papillary muscles. Pericarditis co-exists in the great majority of cases, and very frequently endocardial inflammation also. The pyæmic foci are generally multiple, and vary in size from a pea to a pin's head. They appear at first as small, slightly elevated, yellowish or buff-coloured, softened patches, projecting either on the external or on the internal surface of the heart, and covered with inflammatory deposit. On section, these patches either present an appearance of diffused yellowish softening, or contain one or more collections of dark dirty puriform matter, with ragged, ill-defined boundaries, as if formed by destruction of the discoloured tissue around.

Microscopically examined, the yellowish patches prove to be portions of the myocardium which are infiltrated with pus and granular matter; the muscular tissue itself being in a condition of granular or fatty degeneration. The puriform material represents an advanced stage of the same change, consisting of granular matter and other muscular débris, blood, various micro-organisms, and frequently pus-corpuscles. The several stages of the pyæmic process have been found side by side in some cases; and emboli have been discovered in the branches of the coronary arteries, where they may have served as the foci of the abscesses. The walls of the heart are sometimes in a condition of softening throughout. Pyæmic abscess of the heart occasionally bursts; and the contents make their way either into the left ventricle—producing cardiac aneurysm, and perhaps giving rise to further embolism and pyæmic disease—or into the pericardial sac.

Symptoms.—Whatever the symptoms of pyæmic abscess of the heart may be, they have in recorded cases been completely obscured by the general symptoms of pyæmia, and by the local symptoms and signs of pericarditis. Thus, the patients are described as presenting a febrile, typhoid, or pyæmic appearance, an anxious look, dyspnœa, and præcordial pains; and pericardial friction has generally been discovered over the heart. Delirium probably occurs more frequently than in ordinary cases of pyæmia, but may be referable to the accompanying pericarditis. The *physical signs* found in these cases are chiefly those of acute pericarditis. Sometimes an endocardial bellows-murmur may be heard, due either to valvular lesion, or to the formation of an acute aneurysm of the cardiac wall.

Course and Terminations.—The cases of pyæmia in which the heart has been found *post mortem* to be involved, have generally proved rapidly fatal, the patients dying from exhaustion. Rupture of the abscess in either direction may tend to accelerate the fatal termination; but complete rupture of the wall in both directions, with sudden death from hæmato-pericardium, as in non-pyæmic abscess of the heart, does not appear to be on record.

Diagnosis.—In every case of pyæmia the physical condition of the heart should be regularly investigated; and there should no longer be any risk of acute inflammation of the heart or pericarditis being mistaken for meningitis or simple delirium. Pyæmia with multiple arthritis and involvement of the heart is more difficult of diagnosis from ordinary acute rheumatism with cardiac inflammation; and mistakes in such cases have not infrequently occurred. The history of the case, including the evidence of a definite injury, however slight, is of the greatest value; but a careful consideration of all the facts of the case alone can prevent mistakes. The only difficulty that remains in the diagnosis of pyæmic abscess of the heart is the determination of its existence in the presence of pericarditis, which is rarely absent. For this purpose the facts of the ætiology of the case are more important than the symptoms; and especially the occurrence of an injury to the periosteum of a youthful subject as the original cause of the pyæmia. As a matter of fact, the symptoms, either general or local, appear never to have suggested the diagnosis of pyæmic abscess of the heart.

Prognosis.—If a diagnosis of abscess of the heart can be made in pyæmia, the only possible prognosis that can be given is one of speedy death.

Treatment.—The treatment of pyæmia affecting the heart cannot be said to differ in any important respect from that of ordinary cases of the disease (*see* Pyæmia). The accompanying pericarditis will call for local treatment.

J. Mitchell Bruce.

HEART, Rupture of.—The heart is liable to rupture from external injuries, and from causes acting from within. The latter are called spontaneous ruptures, and these only will be considered here. Spontaneous ruptures may affect either the walls or the valves. The latter form of lesion will be found discussed under the head of Heart, Valves and Orifices of, Diseases of.

Ætiology.—Rupture of the walls may be said never to occur spontaneously when the heart is healthy. The following have been enumerated by different writers as the diseased conditions of the heart's walls that *predispose* to rupture:—A thin or atrophied condition, simple softening, a 'gelatiniform' condition of the walls, apoplectic or hæmorrhagic effusion into the walls, abscess, ulceration, and fatty degeneration. The writer finds from a table of 100 cases of rupture, the histories of which he has collected from different sources, that the heart had undergone fatty degeneration in 77; in 6 the walls were described simply as being softened; in 1 there was rupture of an aneurysmal dilatation; in 1 there was bursting of an abscess; in 12 the heart is said to have been healthy in texture, or not to have been examined; but in most of these latter cases mention is made of the previous existence of endocarditis, or of changes in the coronary arteries, fully justifying the impression that there was disease of the texture of the heart.

The influence of *age* in relation to rupture of the heart can be distinctly traced. For example, of the 100 cases just referred to, 63 were above the age of sixty years. Arranged in decades, the cases stand thus:—2 were between ten and twenty; 1 between twenty and thirty; 3 between thirty and forty; 6 between forty and fifty; 13 between fifty and sixty; 33 between sixty and seventy; 24 between seventy and eighty; 6 were over eighty; and in 2 the age is not stated. With respect to *sex*, of 98 out of 100 cases in which it is mentioned, 54 were males and 44 females.

The *exciting* cause of rupture of the heart is usually some mental excitement or physical effort; but the accident may occur when the subject of it is at rest, or pursuing the ordinary avocations of life.

Anatomical Characters.—*Seat.* In 76 cases out of the 100 to which we have already alluded, the left ventricle was the seat of the rupture; and in 43 of these cases the lesion was in the anterior wall. The right ventricle was found ruptured thirteen times, nine instances occurring in its anterior wall. The right auricle was ruptured seven times; the left auricle twice; and a rupture was found in the septum four times. These results correspond remarkably with those of other writers on the subject. Elléaume (*Mon. des Hôpit.*, 1858) in 55 cases found the rupture 43 times in the left ventricle, seven times in the right ventricle, three times in the right auricle, and twice in the left auricle.

On examining a heart in which rupture has occurred, the torn part is found to present different characters in different cases. The lesion may be *complete*, causing perforation of the walls; or it may be *incomplete*. In *complete* rupture the opening is sometimes barely sufficient to admit a probe, whilst in other instances it may be two or three inches in length. The rent is sometimes longer externally, and sometimes it is longer internally. There may be but one, or there may be more than one, rupture; and in the latter case the ruptures may or may not communicate with one another. In *incomplete* rupture the injury may be confined to the internal surface, or to the external surface, or it may occur in the substance of the walls. The edges of the rent are ragged, irregular, and sometimes ecchymosed. The irregularity of the edges is due to the manner in which the muscular fibres are torn, whether across or split longitudinally. This description refers more correctly to rupture in a heart that is the subject of fatty degeneration. The appearances are different when the rupture is secondary to an abscess, or to ulceration, or to certain other causes presently to be described. In such cases the lesion has been described as a rent, tear, ulceration, or perforation. The condition of the heart in the majority of cases of rupture has been already referred to under the head of *Ætiology.* Ecchymoses are sometimes found in the vicinity of the lesion. The pericardium generally contains an effusion of blood, which often surrounds the heart with coagulum, leaving the sac filled with serum, to the amount, it may be, of thirty ounces, as in an instance which came under the writer's notice.

Mechanism.—Rupture of the heart is doubtless nearly always the result of a strain or of pressure acting upon the muscular walls. The walls of the healthy heart are sufficiently strong to resist any ordinary force to which they are exposed. But when they are softened by degeneration, or are very thin, as is sometimes the case in the auricles or the right ventricle, they may give way before the pressure to which they are exposed during muscular efforts or strains, or even in the ordinary action of the organ. Thus, when a part of the wall of the heart is weakened by softening or other cause, this spot may be, as it were, torn across by the contraction of the healthy fibres among which it is situated. Or again, when the walls of the heart are thick, it may be that the outer surface, being strained over the contents of a distended ventricle, as would be the outer surface of an overbent hoop, gives way, tears, and the opening gradually extends from without inwards. These facts enable us to understand why rupture is more frequent in the left than in the right ventricle. A further explanation is to be found in the fact that the left ventricle is more frequently than the right the seat of fatty degeneration, from causes elsewhere alluded to (*see* Heart, Fatty Degeneration of). There is yet another way in which softening leads to rupture. A softened spot occurs in the substance of the heart, and into it hæmorrhage takes place, constituting what is termed *apoplexy of the* *heart.* At times this hæmorrhagic softening may yield either externally or internally, and give rise to rupture. Lastly, the writer has seen more than once a small spot of softening with loss of substance occurring on the internal surface of the ventricular wall, most frequently in the left; this softening and breaking down of tissue gradually insinuates itself amongst the muscular fibres, until finally perforation of the outer wall of the heart occurs.

Symptoms.—The symptoms of rupture of the heart may be described as those which are premonitory; and those which occur at the time of the accident. The former are such as indicate a diseased condition of the organ—namely, breathlessness on exertion, palpitation, more or less irregularity of pulse, and faintness. In some instances recorded these symptoms were so slight as hardly to attract attention; in others so severe as to cause intense suffering. In the majority of the cases noted in the table referred to, no mention is made of any preceding symptoms, death being sudden. In several cases it is distinctly stated that no symptoms preceded the fatal attack.

The occurrence of the lesion itself, when the patient has lived long enough to describe his sensations, has always been marked by intense cardiac suffering, more or less distress in breathing, restlessness, rapid and irregular pulse, faintness, pallor, coldness of the skin, sometimes vomiting, and by various nervous symptoms. When life is prolonged beyond a few minutes, there may be more or less intermission in the progress of these symptoms; but the whole attack is marked by anguish more or less severe. The duration of the attack itself from the first fatal seizure varies remarkably. In 71 out of the 100 cases alluded to, death was sudden, occurring within one or two minutes. One patient, however, lived eight days, 1 six days, 1 three days; 5 lived over forty-eight hours, 3 lived under twenty-four hours, and 19 under twelve hours.

The special symptoms indicative of a fatal seizure are, in addition to those already mentioned, severe præcordial pain, dyspnœa, vomiting, cyanosis, pallor, loss of consciousness, and convulsions. These symptoms, or some of them, were noted in 44 out of the 100 cases; and in 24 of these the patient lived for more than five minutes after seizure, and in some of the cases for more than twelve hours. These cases, doubtless, are instances in which the muscular fibres are torn apart layer by layer successively. In the other 20 cases the patient was seized with severe pain, and then expired; or with dyspnœa and some of the other symptoms mentioned above, and lived but a few seconds.

The *physical signs* of complete rupture having occurred, so far as can be ascertained, are merely a greater or less amount of dulness in the region of the heart; the impulse diminished; the sounds muffled, distant, or imperfectly developed; and the pulse weak and intermittent.

Course and Terminations.—The difference in the progress of the fatal malady depends much upon the seat of the rupture, on the size of the opening, and on the rapidity with which the extension of the laceration takes place. In the cases in which the septum is torn, there is no external hæmorrhage, and life is prolonged until the patient dies from disturbance in the functions of such an important organ as the heart. (*See* a case reported by Dr. Peacock, *Path. Trans.* vol. v.) The progress of the symptoms is also influenced by the direction and course of the rupture. If the torn fibres overlap from the inside or from the outside, the injury penetrates slowly through the cardiac wall, and the fatal progress is also slow. (*See* cases recorded by the writer in the *Path. Trans.* vol. iii., and also in vol. xii.; and a case by Dr. Peacock in vol. xvii. of the same *Trans.*)

Prognosis.—As far as is known, rupture of the heart is always fatal. Still it is possible that such an accident, owing to the small size of the opening, its incomplete character, and its occlusion by a coagulum, may not prove fatal. Numerous instances are recorded of severe wounds of the heart, the subjects of which have survived. Ollivier has collected 29 such cases, only two of which proved fatal within forty-eight hours, the others living from four to eight days. Cases are recorded in which persons have survived many years severe wounds of this important organ. These cases, however, differ from those of rupture in this particular, that they occur in the healthy organ, whilst spontaneous rupture occurs in the heart when it is seriously diseased. *See* Heart, Wounds of.

Treatment.—In the way of treatment of rupture of the heart little can be done. The patient's sufferings may perhaps be relieved by the hypodermic injection of morphine, or by the use of sedatives or antispasmodics. Perfect rest should, if possible, be maintained.

Richard Quain.

HEART, Softening of.—This term was formerly applied to several conditions of the heart in which the consistence of the cardiac tissue was diminished, whilst the process to which it was due was obscure or anomalous. It is probable that under the name of softening of the heart there were especially included instances of acute myocarditis, parenchymatous degeneration, and fatty degeneration. In the present more advanced state of cardiac pathology, it seems desirable that the expression 'softening,' while retained to express a familiar physical condition, should cease to be employed as a classifying term—that is, to designate any specific morbid state.

J. Mitchell Bruce.

HEART, Syphilitic Disease of.—Syphilitic disease of the heart is by no means a rare condition, having been found in a large number of instances in which the specific nature of the lesion was determined with certainty; whilst, in another series of cases, similar anatomical appearances were present, although the existence of syphilis was not ascertained. Syphilitic disease of the heart is therefore of much pathological interest; but it cannot be said that a great deal is known as yet with respect to its clinical history.

ÆTIOLOGY.—There appears to be nothing of importance known as to the causes of the location of syphilis in the heart. The congenital as well as the acquired form of the disease has been met with.

ANATOMICAL CHARACTERS.—This morbid condition presents two leading appearances *post mortem.* The first is the well-marked syphilitic *gumma*, which closely resembles the same form of growth as it is met with, for example, in the liver and testicles. Gummata of the heart appear as pale yellow patches in the cardiac wall, or as yellowish nodules which are found on section. They present a variety of appearances, according to their age. When young they are firm or even scirrhoid, elastic, and homogeneous; creak on section; and are very slightly succulent: when older, they become soft and cheesy, like a mass of 'yellow tubercle.' In either form the masses are not isolated, but pass continuously into the myocardium, either directly, or through the medium of soft vascular connective tissue, so that they were formerly described in this country as 'infiltrations' or 'fibrinous deposits.' The superjacent endocardium or pericardium is vascularised and dull in the early stage of the nodules; opaque and thickened in the more advanced stage. The masses or nodules occur in various numbers in different instances, but are generally multiple. They may be found in any part of the heart. Gummata most frequently become caseous in the centre, as described; and they may then soften more completely and discharge inwards, leading to acute cardiac aneurysm and ulcer of the wall; but more frequently the cheesy products are in a great measure absorbed, leaving a puckered fibroid patch behind.

The second form of syphilitic disease of the heart is the *fibroid patch.* This is sometimes well-defined and localised, and in such instances it represents the stage of full development of an area of ordinary syphilitic interstitial inflammation. In other specimens, the fibroid patches appear as irregular masses of indurated fibroid tissue, occupying part of the wall of the heart, and sending septa into the depth of the myocardium, whilst the endocardium and pericardium that correspond to them are opaque, thickened, and puckered. The syphilitic nature of such patches may be determined by the presence of specific lesions in other viscera.

A form of the disease intermediate between the two forms just described is one in which the outer zone of the gumma has undergone development into fibroid tissue, and the caseous centre remains as a 'fibrinous' mass.

The microscopical characters of syphilitic growths do not require to be described here. In the heart, the primary seat of the disease is the intermuscular tissue; the muscular fibres lying imbedded in the gummatous products or in the fibroid growth being either healthy in appearance, or fattily degenerated and broken up.

Syphilitic endarteritis (*obliterans*) may also occur in the vessels of the myocardium, and give rise to infarction of the walls of the heart.

Amongst the occasional effects of syphilitic disease of the heart are chronic aneurysm of the walls; distortion of the ostia and of the valves and their appendages; and, more frequently, adhesion of the pericardium. Some of the other viscera present, as a rule, evidence of syphilitic disease.

SYMPTOMS.—The subjects of syphilis of the heart may, from a clinical point of view, be divided into three classes. The first class of patients suffer from some one or other of the ordinary symptoms of chronic cardiac disease, such as dyspnœa, cardiac distress, palpitation, pulmonary complications, and general dropsy; whilst the physical signs are those of cardiac enlargement, and perhaps of valvular incompetence. Præcordial uneasiness, syncopal attacks, and remarkable infrequency of the pulse, have been prominent features in several recorded cases.

The second class of subjects of this disease die suddenly, after few if any complaints referable to the heart.

The third class die of syphilitic marasmus, and may or may not present some evidence —by physical signs or otherwise—that the heart is not sound.

In many of the cases, other symptoms of visceral syphilis have been prominent—for example, phenomena connected with the brain and nervous system.

DIAGNOSIS.—Well-defined symptoms or physical signs connected with the heart, such as those just mentioned, occurring in a syphilitic subject, would furnish considerable grounds for the diagnosis of specific cardiac disease, in the absence of other more probable causes—such as a history of endocarditis, strain, or Bright's disease.

PROGNOSIS.—If such a diagnosis were positively made, the prognosis would be more favourable than it is perhaps in any other form of chronic heart-disease, inasmuch as the condition might be successfully removed by treatment.

Treatment.—Anti-syphilitic remedies, especially iodide of potassium, should be freely tried, along with the other remedies indicated on general principles.

J. Mitchell Bruce.

HEART, Thrombosis of.

—Synon.: Heart-clotting; Fr. *Thrombose Cardiaque*; Ger. *Gerinnungen im Herzen*; *Herzpolypen.*

Definition.—Coagulation of the blood within the cavities of the heart during life.

Ætiology.—Thrombosis of the heart is most frequently due to local arrest of the movements of the blood, comparatively or absolutely, within its cavities. Such arrest is itself generally referable to weakness of the cardiac contractions, whether associated with dilatation secondary to valvular, renal, or pulmonary disease, or due to some primary affection of the muscular walls. The peculiar saccular condition of the extremities of the auricular appendages, and the trabecular arrangement of the columnæ carneæ of the ventricles, as well as the distance of the same parts from the main blood-currents, determine the favourite localisation of the thrombosis. Roughening of the endocardium is another cause of thrombosis, but one which is to be considered less common than the causes already mentioned, unless the fibrinous coagula of endocarditis, or vegetations, be regarded as thrombi, which, in the strict sense of the term, they partly are. Possibly certain conditions of the blood may contribute to the occurrence of cardiac thrombosis. Finally, thrombi once formed tend to promote the further progress of the condition.

Anatomical Characters.—Coagula found within the heart are of two kinds, which have been termed *active* and *passive*, according as they are formed during life, or at or after death, respectively; and the characters of the former, with which alone we are here concerned, cannot be understood until those of the latter have been briefly described.

Passive coagula are found in the heart in most necropsies, occupying the track of the principal blood-currents. Frequently they appear as black or red blood-clots, occupying the auricles principally, and moulded in their cavities. In other cases they take the form of masses of firm whitish fibrin, cleaving with some tenacity to the endocardium, but not truly adherent; matted with the chordæ tendineæ and columnæ carneæ; and projecting some distance into the pulmonary artery. Or, thirdly, passive coagula may be a combination of the two previous forms, the upper part (according to the position of the body) being decolorised or fibrinous, and the deeper part resembling more an ordinary blood-clot. In certain cases these passive clots are peculiar. In phthisis and other diseases proving fatal by very slow exhaustion, they are remarkably firm and fibrinous, and closely matted amongst the chordæ tendineæ—appearances which seem to indicate that coagulation was slowly proceeding for some time before the heart had finally ceased to beat. In anæmia they are jelly-like and translucent. In leukæmia they are soft and creamy in appearance, and yield, when broken up, a puriform fluid. In the acute exanthemata these passive clots are soft and friable; and in many cases of these and of other forms of acute disease and of sudden death, no coagula are found in the heart, which contains only fluid blood.

Active coagula—the result of thrombosis of the heart—are, on the contrary, situated in the saccular appendages of the auricles, at the apex of the ventricles, and in the recesses behind and between the columnæ carneæ—in other words, as far as possible from the track of active blood-currents. In these situations they may be seen projecting in the form of fleshy knobs or globes, with their free surface smooth and rounded. Their deep surface is adherent to the endocardium, from which, however, it can generally be separated without much difficulty, leaving behind it a discoloured mark. If the thrombus be incised, it will be found to be laminated in structure, somewhat after the fashion of an onion, the colour of the section being greyish-brown or yellowish, with irregular patches of red and black. In most instances the centre is less firm than the periphery; and usually it is of a fluid consistence, in the form of a foul, sanious, puriform substance.

If the process of thrombosis have been proceeding for some time, these formations may extend in all directions, embrace the columnæ carneæ, coalesce in front of them, and finally may fill up a considerable portion of one, or even of more than one, cavity. The thrombi are generally friable; but sometimes they gain in firmness by the deposit of lime-salts within them; and at other times it is possible that they become detached and form into the 'fibrinous balls' which have been found lying free in the cavities of the auricles. Cardiac thrombi may, in part at least, be reabsorbed. They frequently give way during life; and portions of them, as well as of their puriform contents, are conveyed into the circulation, causing embolism and pyæmia.

Cardiac Embolism.—It may be added that embolism of the heart has frequently been found—thrombi or simple clots, sometimes of remarkable size, having been carried from the veins, and arrested in the heart or in the mouth of the pulmonary artery.

Symptoms.—The clinical phenomena associated with true cardiac thrombosis may be best described as those of the last stage of chronic disease of the heart. Præcordial distress and restlessness; irregularity and feebleness of the pulse; œdema and coldness of the extremities; pulmonary congestion, infarction, and œdema; dulness of expression, and sopor, broken by low weak delirium; with other symptoms, as well as with the signs of cardiac failure and imperfect emptying of the cavities in systole—all these phenomena are associated with the process of active coagulation within the heart. It would not, however, be correct to describe these phenomena as symptoms directly referable to the thrombosis. All that can be said is, that in such a case thrombosis is probably going on and increasing the embarrassment and the gravity of the condition. An unusual degree of cyanosis appears in some instances. The symptoms of arterial embolism may suddenly make their appearance from detachment of particles of the clots; and, if the puriform contents find their way into the circulation, septicæmia may result.

Cardiac embolism.—The dislodgment *en masse* of a large venous thrombosis, and the impaction of the same, or of a 'fibrinous ball,' in one of the ostia of the heart have frequently caused rapid death. *See* PULMONARY VESSELS, Diseases of.

Passive coagulation.—It should be added that the appearance of the 'passive' form of coagulation within the heart, which has been already referred to as a *post-mortem* process, or one occurring *in articulo mortis*, has been otherwise interpreted by some authorities, who regard passive coagula as formed *ante mortem*, and as giving rise to severe symptoms by the embarrassment which they produce in the circulation. The symptoms caused by this condition are said to be—great præcordial pain and distress; tumultuous action of the heart, passing on to irregularity, flickering, and finally arrest, whilst the pulse is very feeble; urgent dyspnœa; cyanosis; hæmoptysis; coldness of the extremities; deepening stupor; and coma ending in death—in short, the congeries of symptoms which would be referred by most authorities to failure of the muscular walls of the heart, the coagulation being regarded as only another result of the same condition.

DIAGNOSIS.—In the presence of the very serious and complex conditions with which cardiac thrombosis is usually associated, the question of its existence can hardly be said to occur to the physician as a point of great importance. An unusual degree of cyanosis, especially if it be progressive, favours the recognition of this state; and in the absence of valvular disease, the occurrence of embolism or pyæmia would tend to confirm it.

TREATMENT.—The treatment of cardiac thrombosis consists in the treatment of its cause; and nothing is demanded or can be done for the former which is not indicated for the relief of the latter. Those authorities who see in 'passive' coagula the evidence of rapid *ante-mortem* thrombosis, recommend the use of stimulants, and even of certain drugs which are supposed to have a solvent effect on fibrinous formations, especially ammonia.

The treatment of *embolism* of the pulmonary artery is described separately.

J. MITCHELL BRUCE.

HEART, Tuberculosis of.—Independently of the pericardium, the heart itself is believed to be rarely the seat of tubercular disease. Grey miliary tubercles have been found in the connective tissue of the wall of the heart, in some cases of acute general tuberculosis. Tubercle bacilli occasionally occur on endocardial ulcers. In other instances the 'tubercle' has been of the yellow or cheesy kind, in the form of small nodules lying at various depths in the muscular tissue beneath the pericardium; the latter also being frequently affected, as well as the lungs, intestines, and other organs.

There appears to be no evidence that tuberculosis of the myocardium gives rise to definite symptoms, or that it can be recognised during life.

J. MITCHELL BRUCE.

HEART, Valves and Orifices of, Diseases of.—CLASSIFICATION.—The diseases of the valves and orifices of the heart which produce mechanical disorders of the circulation, by establishing abnormal relations between those parts, are of two kinds—*obstructive* and *regurgitant*. Valvular disease, on the one hand, is said to be *obstructive* when narrowing of an orifice presents an obstacle to the passage of the blood-current—a condition better named *stenosis*. On the other hand, when the blood regurgitates or flows back through an orifice, in consequence of imperfect closure of the valves, due either to valvular changes or to widening of the orifice, the condition is called *regurgitation* or *insufficiency*.

Aneurysm of the valves of the heart is discussed separately. *See* HEART, Valves of, Aneurysm of.

ÆTIOLOGY.—Each of the orifices may be affected with one or both forms of disease, but the frequency with which the several orifices are attacked varies. The results of organic disease are chiefly met with in the left side of the heart, and are due to local inflammation—endocarditis and its consequences; or to chronic degenerative changes, such as atheroma. In adult life the valves of the left side are more frequently affected than those of the right, because they have to bear a much greater pressure; but in fœtal life, when the pressure is reversed, the right valves suffer more. Endocarditis is commonly of rheumatic origin, and attacks the mitral more frequently than the aortic valves; the former having to sustain the full force of the ventricular systole, while the latter only bear the force of the aortic recoil. In addition to rheumatic fever, the chief diseases which tend to develop endocarditis are pyæmia, puerperal fever, the exanthemata, diphtheria, chorea, typhoid, tuberculosis, chronic renal disease, and syphilis. The aortic valves and orifice are more commonly affected than the mitral by chronic endarteritis extending from the aorta, the chief causes of which are gout, old age, syphilis, and the abuse of alcohol. These facts explain why mitral affections (commonly rheumatic) occur mostly in early life, and aortic affections in later life. Valvular lesions are more common in men than in women, from the strain of the heart incidental to more laborious occupations. Strain helps to swell the greater proportion of disease of the aortic valves, which are liable to rupture from effort; but similar accidents may occur to the mitral valve and its tendinous cords. Valvular defects are also due in some cases to congenital malformations.

Anatomical Characters.—The pathological changes in the valves and orifices of the heart, which cause valvular diseases, are mostly the results of acute or chronic endocarditis. In the acute form, the valvular lesion is caused by the growth of vegetations which interfere with the action of the valve-segments; or by softening and ulceration of the valve-structure, which lead to valvular aneurysm and perforation, or to loss of substance and consequent insufficiency. The more chronic form of inflammation produces thickening of the valves from overgrowth of the connective tissue, with subsequent calcareous degeneration, and retraction from shrinking of the hyperplastic connective tissue; or adhesion of the valve-segments causing stenosis.

Aortic stenosis is generally the result of thickening and calcareous degeneration of the valves, or of deformity of the valves from vegetative growths which obstruct the free passage of the blood from the ventricle. Sometimes it is due to adhesion of the valves preventing their elevation, and causing them to form a diaphragm with a narrow central aperture. More rarely it is caused by thickening and contraction of the fibrous ring of the aortic orifice, gradually involving the valves; or by endocardial thickening producing contraction immediately beneath the aortic ring.

Mitral stenosis results most frequently from a leather-like thickening and rigidity of the valves, which contract all round the mitral orifice, so as to narrow the outlet, and form a diaphragm between the auricle and the ventricle. This diaphragm is in some cases funnel-shaped, while in others the mitral orifice is transformed into a button-hole aperture, or narrowed to the size of a goose-quill. The tendinous cords of the valve are shortened, and their muscles thickened. In some cases the valves are smooth and thin; in others they are thickened, studded with vegetations, rough and calcareous. This latter state may cause stenosis, without any funnel-formation, as may also fibrinous clots or polypi obstructing the orifice. In many cases of mitral stenosis the valves are also insufficient. Mitral stenosis is mostly observed in young females, as a result of mild rheumatic attacks or chorea. It is sometimes called congenital in cases in which it can be referred to no acute illness.

Aortic insufficiency sometimes depends on dilatation of the aortic orifice, due to softening of the aortic coats, with little or no change in the valves, which are incapable of closing the enlarged orifice. This may be called *relative* insufficiency. Vegetations, thickening, retraction, calcareous degeneration, adhesions, perforations, loss of substance, and rupture of the valve-segments by effort are all causes of aortic insufficiency. In rupture of the valves, a full description of which was first given by Sir Richard Quain (*Edin. Monthly Journ.* 1846), the valve-segment is torn from its angle of attachment, and its free edge retroverted towards the ventricle. This accident happens more frequently in cases where the valves were previously diseased by chronic inflammatory changes connected with the strain of very laborious occupations, and in such cases further laceration may subsequently occur.

Mitral insufficiency is due to thickening, retraction, or deformity from vegetations of the valve-curtains; adhesion of the curtains to each other or to the ventricular wall; and calcareous degeneration. In some instances, one of the valves is perforated or torn; and sometimes the tendinous cords are shortened and thickened, or ruptured as the result of degeneration, preventing the normal action of the valve-curtains. In rarer cases associated with dilated ventricle, the papillary muscles are so weakened by degeneration that they can no longer aid in the closure of the orifice. Dilatation of the left auriculo-ventricular orifice is also a cause of *relative* mitral insufficiency. This form is unconnected with structural valve changes, and is due to defective muscular contraction, such as occurs in anæmia, typhoid fever, and the failing systole of the later stages of aortic insufficiency.

Valvular defects on the right side of the heart are due to similar changes. They arise chiefly during fœtal life, when the right cavities have to bear greater pressure. In adult life these defects are generally associated with diseases of the lungs, which cause increased tension in the right cavities, and lead to their dilatation.

Combined valvular lesions are not infrequent. The most common are stenosis and insufficiency of the aortic valves, and the same morbid changes of the mitral valves. In the last stages of both forms of aortic valve-disease, the mitral valve becomes insufficient, either from chronic endocarditis, or from dilatation of the ventricle and of the auriculo-ventricular orifice. Mitral stenosis is not infrequently associated with aortic insufficiency, but is more commonly connected with some degree of narrowing at the aortic orifice. Tricuspid insufficiency is usually met with in the last stages of diseases of the left heart; and tricuspid stenosis is met with in connexion with a similar narrowing of the mitral orifice.

SYMPTOMS.—Valvular diseases of the heart produce a series of morbid phenomena, which are connected together by a necessary sequence. Each and every form of valvular defect impairs the perfection of the heart as a pumping machine, and disturbs the normal relations between the contents of the arteries and of the veins. Wherever the valve-mischief is, and whatever its nature, it robs the arterial circulation and enriches the venous. In front of the lesion there is less blood; behind it there is more. In aortic valvular diseases, the first effects are increase of the blood-pressure in the left ventricle, and lessened blood-pressure in the aorta; next, from the difficulty which the left auricle has in emptying all its contents into an over-full ventricle, there is produced increased pressure in the left auricle and pulmonary veins. Mitral valve-lesions cause similar results: first, increased pressure in the left auricle, less pressure in the left ventricle, and consequently lessened pressure in the aorta; with a gradual increase of pressure extending from the left auricle to the pulmonary veins. Aortic affections thus act first on the arterial, and secondly on the pulmonary circulation; while mitral lesions affect the pulmonary vessels more immediately. The final results of the two forms are, however, identical, and may be stated in the form of a law—namely, that all valvular diseases of the heart tend to lessen the quantity of blood in the arterial system, and to produce increased fulness and stasis in the veins. From the action of this law, various associated visceral disorders follow as consequences. These disorders, however, vary greatly in the period of their occurrence, and in the intensity of their manifestations. This variation is due to the more or less perfect way in which the original valvular defect has been compensated for, by changes in the power of the cardiac muscle and in the capacity of the cardiac cavities. These changes often suffice to maintain fairly the normal balance between the arterial and venous contents, thus *compensating* for the valve lesion; and the process by which this is effected demands careful consideration.

Compensation.—Compensation is effected differently, according to the form of disease. It may be stated, generally, that it consists in hypertrophy of the cavity immediately behind the defect. Now hypertrophy means increased contractile power, and this means better filling of the arteries, and consequently increased arterial tension. Thus it makes up for the valvular incompetency, which tends to lessen arterial tension. When the increased power of the ventricle exactly balances the effects of the valvular mischief, the compensation is complete.

In *aortic stenosis*, hypertrophy of the left ventricle is the mode in which compensation is effected; the obstacle to the blood-current is overcome by the increased muscular power.

In *aortic insufficiency* there is some dilatation of the ventricle as the primary result of the lesion. This is counterbalanced by greater hypertrophy; and as long as the dilatation does not progress, the insufficiency is compensated for. A sufficient excess of blood is thrown into the aorta at each systole to allow for the regurgitation during each diastole; and thus the balance is maintained, though not always equably.

In *mitral lesions* the left auricle is dilated as the primary consequence of the condition of the valves; hypertrophy follows, but is insufficient to prevent increased fulness of the pulmonary veins. This impedes the circulation in the lungs; and increased tension in the pulmonary artery soon begets the necessary hypertrophy of the right ventricle. It is by means of this increased power of the right ventricle that the blood is driven through the lungs in spite of the defect in the left heart, and pulmonary stasis is prevented; and the blood entering the left auricle under greater *vis à tergo*, the compensation of the valvular defect is effected. The compensation, from the nature of the means on which it depends, is manifestly less perfect than in aortic lesions.

On the *right side of the heart* similar modes of compensation are observed.

The basis of the salutary changes just described is increased cardiac nutrition; and, consequently, a free coronary circulation is a necessity. Conditions which interfere with this prevent compensation, and so diminish the duration of life. Wherever the compensation begins to fail, dilatation of the cavities and vessels behind the lesion commences. This may, however, be checked, and the power of the heart restored for a time. Sooner or later, however, changes in the nutrition of the cardiac muscle, in the vessels, and in the general nutrition, bring on failure of compensation. The cardinal symptom in such cases is weakened contractile power of the heart, or *asystolie* (Beau). In this state, the cavity chiefly affected has no longer power to expel its contents fully into the vessels, and consequently becomes gradually and increasingly distended. Failing compensation in aortic valve-disease manifests itself by dilatation of the left ventricle, and the development of secondary mitral insufficiency. Similar retro-dilatation marks the failure in mitral cases, only here it is the right ventricle which dilates, and tricuspid insufficiency and general venous stasis are added to the pre-existing pulmonary engorgement.

The earliest *symptoms of failing compensation* are attacks of palpitation from very slight exertion or excitement, or during sleep. Irregularity of the pulse soon follows, if it have not previously existed. This is especially the case in mitral disease. The irregularity is due not so much to true cardiac intermission as to abortive contractions, which do not reach the wrist; or to contractions unequal in force, or in the quantity of blood expelled. The pulse is small, unequal, irregular, and compressible. In aortic valvular disease true intermissions occur, and are of grave import. With failing cardiac power there usually supervene cardiac oppression, anginous attacks from distension of the cavities of the heart, and faintness and giddiness from cerebral anæmia.

Visceral complications.—The most important of the associated disorders of chronic valvular disease, depending on defective contraction of the heart, are the visceral congestions.

In the *lungs*, the habitual engorgement of mitral diseases produces a hyper-secretion of mucus and a state of chronic catarrh. The blood-vessels also undergo changes from the excessive intravascular pressure, and become dilated, varicose, and atheromatous; whence œdema and hæmorrhage arise. In mitral stenosis especially, grave and frequent attacks of hæmorrhage, with laceration of the pulmonary substance, are liable to occur; these attacks are called pulmonary apoplexy, and the lung-condition splenisation. The lungs, from long-continued congestion and œdema, undergo brown induration. The varicose condition of the vessels in the alveoli interferes with oxidation, both by favouring stasis and by mechanically narrowing the alveoli, and so aids in the deterioration of blood, which the other visceral congestions favour.

In the *liver*, the general venous stasis is felt by the obstruction to the passage of blood from the hepatic veins into the inferior cava. Passive congestion ensues, and 'nutmeg liver' results. This term 'nutmeg liver' refers to the rough changes in the viscus, the dark congested centre of each lobule being surrounded by a paler area. In course of time the compression of the central cells of each lobule by the distended veins leads to atrophy, and the growth of a hyaline fibroid tissue, which causes the toughness; the liver, from being large, shrinks in very chronic cases to half its size; and the condition may, like true cirrhosis, lead to ascites. The passive congestion in the liver, as in the lung, causes catarrh of the tubes, and may thus be productive of jaundice. Amongst other symptoms associated with the hepatic congestion may be mentioned hæmorrhoids and epistaxis.

The *spleen* is a very easily distended organ, and suffers like the liver, but frequently before it; and this may partly account for the pain in the early stages, which is complained of beneath the left ribs. In long-standing cases the spleen becomes tougher, and the capsule opaque and thickened; while hæmorrhagic infarcts are common.

From the hepatic congestion there naturally follows distension of all the other radicles of the portal vein; hence the congestion and chronic catarrh of the *stomach* and *intestines*, which impede digestion and assimilation, and so reinforce the other causes producing the cachexia of chronic valvular disease.

In all cases of valvular disease, when the mechanical effects extend to the general circulation, the function of the *kidneys* is more or less disordered. The first stage of general circulatory trouble is lessened arterial tension; this makes itself felt in lessened pressure in the Malpighian tufts, and is manifested by scanty, dense, high-coloured urine. When the more advanced circulatory trouble—namely, general venous stasis—is developed, a further change takes place in the urine. The arterial anæmia keeps it still scanty and dense, but the venous stasis in the kidney leads to the transudation of serum—a dropsy of the kidney, as it were; and consequently albumen appears in the urine. Long-continued venous congestion ends in structural changes, which, as elsewhere, consist in connective-tissue hyperplasia and degenerative (rarely fatty) changes in the tubules. These renal changes sometimes add uræmia to the patient's ailments.

In the *brain* decided alterations are not found, except when a detached vegetation produces embolism and its special phenomena. The brain-substance is, however, generally œdematous, and the membranes are thickened. Delirium is an occasional symptom in heart-disease, and when present to any great degree is of evil import. The blood-vessels of the general circulation are frequently affected with atheroma in hypertrophy of the left ventricle, and it is these degenerative changes, as well as embolic aneurysm, which favour the occurrence of apoplexy.

General dropsy.—The mechanical impediments to the circulation which produce these several visceral congestions, also manifest themselves in the general dropsy which is common in the last stages of heart-disease. The dropsy begins as a puffiness of the ankles, especially the left, at bedtime. The general venous stasis, thus first indicated, advances slowly and surely, if not checked, to general anasarca, and even to dropsy of the serous cavities. The increased venous tension, and the hydræmia of blood deterioration, are the causes of this serous transudation, which shows itself first in the feet, the most dependent portions of the body, where the pressure of the blood-column is naturally greatest. The horizontal posture, by distributing the pressure, is sufficient at first to disperse the œdema of the ankles. General anasarca is much more frequent in mitral, especially the regurgitant form, than in aortic lesions.

In some cases a solid form of œdema is observed. This occurs mostly in the last stages of valvular affections, and is due to thrombosis of venous trunks, in which, the circulation being much impeded, coagulation easily takes place. The termination of the external jugulars is a common site for such thrombosis; and the left innominate vein, from its transverse position, and from its emptying almost at right angles to the current in the superior vena cava, is, in the writer's experience, more commonly obstructed than the right. Solid œdema is consequently seen more frequently on the left side of the head and neck and in the left arm, than on the right side.

Defective compensation.—The phenomena just described are associated with valvular diseases of the heart, as the consequences of partial or defective compensation. These conditions are more or less developed according to the individual case, and consequently give rise to symptoms in varying degrees. These symptoms will now be described.

Palpitation is intimately related to the state of cardiac nutrition and innervation, and has no special connexion with any form of valvular disease. Cardiac pain, varying in intensity from mere uneasiness to the agony of angina, is most common in aortic cases, and is associated with endarteritis, particularly at the root of the aorta, or with dilatation of the left ventricle, or is a neuralgia of the cardiac plexus. In mitral affections, pain arises from over-distension of the left auricle, and its pressure on neighbouring parts, and later on from dilatation of the right ventricle. Dyspnœa may be present in any form of valvular disease, but it is often absent from the earlier history of aortic cases, while some dyspnœa is always present in mitral cases. This difference is due to the absence of pulmonary congestion in aortic affections, whilst it is more or less present from the first in mitral affections. The dyspnœa is a breathlessness rather than a difficulty of breathing. It is panting and gasping in its character, with acceleration of the rate. It is aggravated by any movement, and often compels the patient to sit upright (orthopnœa). Headache, vertigo, dreaming, night-frights, and sleeplessness are other symptoms, which depend on disordered cerebral circulation. Sleeplessness is one of the most distressing of all symptoms, and can only be relieved when the dyspnœa is lessened. Other more special symptoms will be found in certain cases, and will be traceable to the disturbances in the circulation, which the particular form of valvular disease has engendered.

Physical signs.—The physical signs associated with valvular affections may be said to be—first, those of alteration in the size of the heart; and, secondly, those of mechanical disorders of the circulation; together with one or more endocardial murmurs. The persistence of a murmur is the cardinal sign, and if the murmur be either diastolic or præsystolic in its rhythm it is of absolute value. A systolic murmur may be caused by poverty of blood—anæmia, especially at the base of the heart. But in such a case—that is, in hæmic murmur—there is no cardiac hypertrophy, as indicated by increased cardiac dulness, though there is often nervous over-action of the heart. There is no accentuation of the pulmonary second sound, inasmuch as there is no extra-fulness of the pulmonary blood-vessels from obstructed circulation. The pulse in anæmia is generally quick, ample, and compressible, but, withal, jerky; while with an organic systolic murmur it is generally slow, rising gradually under the finger, and not very compressible (aortic stenosis), or small, irregular, and unequal (mitral insufficiency). The clinical methods of investigating valvular lesions are mainly inspection, palpation, percussion, and auscultation. The signs of each form of valve-disease are stated below; and on these the special diagnosis rests.

Diagnosis.—In *Aortic stenosis* there is often some prominence of the præcordial region, and a steady forcible impulse is perceived below and to the left of its normal position. A thrill, systolic in time, may often be felt at the base of the heart. On auscultation, a loud, frequently rough, rasping, sometimes musical, murmur is heard with the first sound at mid-sternum, and also at the second right intercostal space. The murmur, commencing with the first sound, extends to the succeeding second sound, which is often not very distinct. In relative stenosis with a dilated aorta, the murmur is softer, and the second sound sometimes louder than normal. The murmur of aortic stenosis is audible all over the upper part of the thorax, especially on the right side; is conducted along the great vessels to the left vertebral groove, and it may be even to the lower dorsal vertebræ; and is occasionally heard at the apex of the heart. The pulse is regular, slow, retarded by the narrowing of the aortic orifice, and slowly developed under the finger. The sphygmogram (*see* fig. 62) shows the line of ascent to be oblique or broken, instead of nearly vertical; the summit is generally blunt; and the line of descent shows small or no secondary waves, and ill-developed dicrotism. Aortic stenosis when moderate, requiring only hypertrophy of the left ventricle for its compensation, is often very perfectly remedied by this change, and produces little or no disorder of the circulation. This is also true of cases in which roughness of the valves or vegetations are the cause of even a loud murmur. The amount of hypertrophy of the left ventricle is the surest guide to the gravity of the condition. When the stenosis is very great, epileptiform and syncopal attacks may occur, and lead to sudden death. When the compensation fails, the mitral valve often yields from the dilatation of the left ventricle, and degeneration of the papillary muscles. Then the pulmonary second sound becomes accentuated; the pulmonic circulation is embarrassed; and dyspnœa, bronchial catarrh, pulmonary hæmorrhage, œdema, and cyanosis supervene.

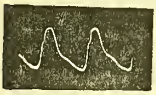
Fig. 62.—Pulse-tracing in Aortic Stenosis.

In *Aortic insufficiency*, inspection discovers a more forcible and diffused impulse, lower than natural, sometimes as low as the seventh intercostal space, and outside the nipple line. The præcordial region may be bulging from the violent action of the heart; pulsation may be seen in the upper intercostal spaces at the right edge of the sternum; and a thrill may sometimes be felt there, and occasionally as low down as the heart apex. The great vessels of the neck pulsate visibly. The area of cardiac dulness is increased in all directions, but mainly vertically. On auscultation, a murmur is heard, replacing and following the second sound, of a blowing or hissing character, rarely rough, and lessening in loudness towards its end. It is usually loudest at mid-sternum and in the second right intercostal space; and it is conducted upwards to the right clavicle, but mainly downwards to the xiphoid cartilage. It is not heard at the back of the chest. It may be conducted to the apex of the heart rather than to the ensiform cartilage; and this occurs, in the writer's opinion, when the posterior or mitral segment of the aortic valves is the incompetent one, as the regurgitant current then falls on the mitral valve, and the murmur is thus conducted to the apex. The second sound may be wholly lost at the base of the heart, being replaced by the murmur; but in some cases it is audible—this being due either to normal closure of one or two aortic segments, or to the propagated pulmonic second sound. If audible in the carotids, the second sound is aortic, and is of some value as indicating partial competency of the valves. The second sound is often audible at the apex. The first sound at the base is almost always modified, being generally murmurish and often obscured by a systolic murmur, due to slight obstruction from thickening of the valve-segments, or to relative stenosis and the vigour of the ventricular systole. In some cases there is no distinct first sound audible at base or apex; its absence being possibly due to noiseless closure of the mitral valve by the intra-ventricular blood-pressure before the systole occurs. Thus in cases of free regurgitation, both first and second sound may be absent over the left heart; but on listening over the femoral artery with a binaural stethoscope lightly applied, the two sounds of the heart can sometimes be heard. In the majority of cases the insufficiency is no doubt associated with some stenosis, and the murmur is double—a short rough systolic portion, with a softer, longer, and more hissing diastolic portion. This double murmur might be well called the *up* and *down* murmur of aortic valve-disease: the two descriptive words indicating the length, and, to some extent, the characters of its component parts.

The signs connected with the pulse in aortic insufficiency are very significant. As the pulsations of the aorta are visible to the right of the sternum, so the arteries often beat visibly all over the body, even to the radial, temporal, and dorsal arteries of the foot. The ophthalmoscope has shown the same phenomenon in the central artery of the retina. This remarkable movement of the arteries is due to two causes—first, to the hypertrophy and dilatation of the left ventricle, which throws an excessive quantity of blood into the vessels at each systole; and, secondly, to the sudden collapse of the arteries, due to the aortic regurgitation. The arterial recoil during the ventricular diastole is not opposed, as in health, by the resistance of the perfectly closed aortic valves, and, consequently, the blood-column is not sustained, and the arteries collapse. These locomotive features in the pulse are generally increased by elevating the arm. The pulse is sudden, short, large, regular, rapidly collapsing, and vibratory. The sphygmographic tracing brings out these characters: the line of ascent is vertical and lofty; the summit is sharp and pointed; the line of descent falls rapidly, and is broken by a series of secondary waves due to vibratory conditions, but has an ill-developed dicrotism. The post-dicrotic portion of the tracing falls rapidly, from the absence of a sustained blood-column. The longer and more oblique this portion of the tracing, *cæteris paribus*, the less copious the regurgitation (*see* fig. 63).

Aortic insufficiency often lasts for many years without producing any obvious disturbance of the systemic and pulmonic circulations; hence the absence of dyspnœa and œdema. The hypertrophy and dilatation of the left ventricle, which form the compensation, suffice to prevent ill effects. At each systole the dilated ventricle throws sufficient blood into the aorta to allow for the reflux, and to maintain a fair arterial tension. Thus the compensation is perfect. In many cases, however, if the reflux is free, and the coronary segments of the aortic valves are affected, the coronary arteries, which are partly filled by the arterial recoil, are deprived of the full force of the blood-wave, and the nutrition of the heart consequently suffers. This is the great source of failing compensation, and the malnutrition of the cardiac muscle soon leads to dilatation of the ventricle, secondary mitral insufficiency, and atrophy.

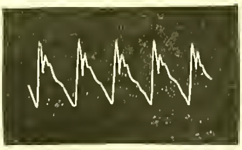
FIG. 63.—Pulse-tracing in Aortic Insufficiency.

When the hypertrophy is excessive (overcompensation), as it is in some cases, there are flushings of the head and face, headache, vertigo, and violent arterial action all over the body.

In *Mitral stenosis* there is rarely any prominence of the præcordial region; and in its earlier stages neither increase of the cardiac dulness, nor alteration in the position of the impulse. The impulse, when regular, is fairly distinct, but it is often very irregular, and is associated with a thrill, which precedes, runs up to, and terminates in the impulse. In advanced cases, the area of cardiac dulness is increased laterally; the impulse is diffused, and may be seen in the epigastrium; this indicates hypertrophy of the right ventricle, which sometimes obscures the left ventricular impulse and gives rise to epigastric and liver pulsation. The left auricular systole may occasionally be noticed, if the chest be thin, in the third left intercostal space. The sounds heard on auscultation in this lesion vary. The pathognomonic sign is a murmur preceding the systole, and ending with its commencement. This is best called the *præsystolic* murmur (also 'auricular systolic'); and is produced when the contracting auricle forces blood under high pressure into the ventricle. It is the passage of a stream of blood in a state of high tension into blood already in the ventricle which causes the murmur. The first portion of the blood passes from the auricle into the ventricle noiselessly; and it is only when a stream of higher tension is forced into it by the true auricular systole that the murmur is developed. The murmur is, therefore, short in most instances, occupying the last part of the diastole; it runs up to the first sound, and ends abruptly in it. The position in which the murmur is best heard in its typical præsystolic form is limited to the left apex itself or a little above—that is, lower than a mitral regurgitant murmur. The funnel-like shape of the mitral valve-curtains in these cases accounts for this, as the button-hole aperture through which the blood passes is closer to the apex.

This murmur is soft and puffing, but may be harsh. It commonly fills only the last part of the diastolic period. In some cases, with greater roughening and deformity of the valves, the murmur is longer, rougher, more rolling or grinding, and ends abruptly with the first sound, which is very flapping in tone, and might easily be mistaken for the second sound conducted. The careful observation of the impulse or of the carotid pulse with the finger while auscultating, is necessary in order to avoid the error. Mitral stenosis develops three murmurs under different conditions of the valves: (1) A short, softish puff (sounding like *vōōt*) immediately preceding the first sound; (2) a short, rough, grinding murmur (*rrrb*); and (3) a long murmur filling nearly all the diastole, often rough, but varying in tone in some cases. These several murmurs increase in intensity up to, and end abruptly with, the first sound. The soft, hissing diastolic murmur, occasionally heard at the apex, which lessens in intensity, and ends before the first sound, is a conducted aortic (or pulmonic) murmur.

A special peculiarity of the præsystolic murmur is its variability: it is the only organic murmur which disappears and reappears as the heart-conditions change. For instance, a murmur, inaudible while the patient is at rest, is developed by a little exercise; or, again, an irregular tumultuous action of the heart masks all murmur, which becomes distinct as the heart steadies down under the action of digitalis. In other cases there is no distinct murmur, but only a slightly prolonged and rough or grinding first sound, while the murmur is often lost as the heart-failure advances. In cases of mitral stenosis there is accentuation of the pulmonary second sound, from the greatly increased tension in the lesser circulation; there may also be a doubling or reduplication of the second sound at the base. This reduplication is a sign of great value in cases in which the prolonged or grinding first sound is the only sign. The reduplication of the second sound is due to a want of synchronous closure of the pulmonic and aortic valves, from their altered relative tension. A doubling of the first sound is sometimes noticed, probably due to retarded closure of the mitral valve, from lessened fulness of the left ventricle.

The rhythm of the heart is frequently greatly disordered in mitral stenosis, and also in mitral insufficiency. A few beats occur regularly, or nearly so, and then a series of very small hurried ones follows, to be again succeeded by stronger and better pulsations. These irregularities are referable to the varying charges of blood on which the ventricle contracts. The over-distended right cavities and the left auricle contract rapidly to expel their contents, but the narrowed mitral orifice does not allow a full charge to pass into the ventricle; the diastole is too short for this purpose; and the wave of contraction passes on to the ventricle from the auricle, producing a series of small ineffective pulse-beats, each representing the small charge sent into the aorta. When the series of ineffective contractions ceases, the next diastole is longer; and the succeeding systole sends, as the sphygmograph shows, a fuller charge into the arteries. During the small irregular beats the præsystolic murmur is often indistinguishable, but it is again heard with the succeeding slower and more effective beats. This irregularity in the heart's rhythm, however, is not present in all cases of mitral stenosis. In some instances the heart's action and the pulse are regular. The sphygmograph in such cases records a small pulse of low tension, with a little inequality in the volume of the beats; this inequality is often increased by exercise. In other cases the pulse-tracing is small, irregular, and unequal in its pulsations, and marked by true and false intermissions (*see* fig. 64).

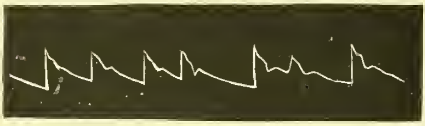

FIG. 64.—Pulse-tracing in Mitral Stenosis.

In the earlier stages of mitral stenosis the face may be pale, and the congestive symptoms which mark mitral insufficiency are absent till the later stages. This form of valvular lesion gives rise more commonly than mitral insufficiency to hæmorrhagic infarction in the lungs; but in other respects the pulmonary and systemic circulations suffer in the same way as described in the other form of mitral disease.

In *Mitral insufficiency* inspection discovers some slight prominence of the præcordial region, with increased impulse, the apex often beating to the left of the nipple line. The area of cardiac dulness is augmented mainly in a lateral direction, from the hypertrophy of the right ventricle. On auscultation, a murmur is heard with the first sound, and following it; loudest at the apex; loud along the left edge of the heart; but absent or not so distinct over the right heart and at the base. The murmur is propagated towards the left axilla, and is audible in most cases in the left vertebral groove. If not audible posteriorly the murmur signifies regurgitation through a narrowed but patent mitral orifice, and may indicate mitral stenosis, in the absence of either a præsystolic or diastolic murmur. The mitral systolic murmur associated with dilated left ventricle or enfeebled muscle is not usually heard posteriorly. The murmur is usually loud, blowing, and distinct in its character, keeping the same tone throughout. The true first sound is generally obscured by it, but in some cases may be heard through it, and is then due to the partial closure of the mitral, or to the action of the right auriculo-ventricular valves. The pulmonic second sound is commonly accentuated. The pulmonic first sound has in some cases a murmurish character, probably due to hypertrophy and dilatation of the right ventricle, and relative stenosis of the pulmonic orifice.

The radial pulse in cases of fairly perfect compensation is regular, but quick, small, weak, and easily compressible; and the sphygmograph shows low tension, and an inequality in the size of the pulsations. In cases of less perfect compensation, it becomes irregular and intermittent. In all cases the pulse-beat is weak in comparison with the vigour of the ventricular systole (*see* fig. 65).

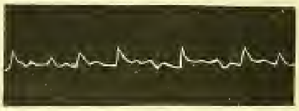

FIG. 65.—Pulse-tracing in Mitral Insufficiency.

There is no unusual fulness of the superficial veins in the earlier stages of mitral insufficiency. Later, when the right cavities become over-distended, the veins of the neck become full and may even pulsate. This is very distinct when the tricuspid valve gives way. In all cases slight exertion is sufficient to induce dyspnœa; and there is an ever-present tendency to bronchial catarrh, from the congested state of the lungs. When asystole comes on, the murmur becomes less distinct; the heart's action is rapid, irregular, and tumultuous; the accentuation of the pulmonary second sound is lost; dyspnœa becomes orthopnœa; and cyanosis, œdema, and hæmorrhagic infarction of the lungs, with general and visceral dropsy, close the case.

Many cases of mitral regurgitation obtain fairly perfect compensation; but the disease, like mitral stenosis, of necessity entails some dyspnœa on exertion, and keeps up constantly an engorged state of the pulmonary vessels.

Valvular affections of the right heart, arising from disease, are rare. Those of the *pulmonic valves* are rare; cases are on record, however, of pulmonary stenosis, and a few of pulmonary insufficiency. In the first case the systolic murmur is loud and superficial, and is heard loudest at the third left costal cartilage close to the sternum, and in the second left intercostal space; it is not usually conducted across the sternum, nor upwards to the right clavicle, as is an aortic murmur. A diastolic pulmonic murmur is soft and blowing; and is heard loudest in the same situations, and downwards towards the ensiform cartilage.

The *tricuspid valves* are more frequently affected. Tricuspid insufficiency is indeed a common sequence of disease of the left side of the heart. Structural changes in these valves are, however, rare. Tricuspid insufficiency does not always produce a murmur; when present this is soft and short, and is heard nearer the middle line than a mitral murmur, at the base of the ensiform cartilage. The pulsations of the cervical veins may indicate the lesion when the murmur is absent.

Tricuspid stenosis causes a præsystolic murmur, harsh in character, loudest at the base of the ensiform cartilage and towards the left edge of the sternum, not propagated towards the left heart, and not audible at the back of the chest, though faintly conducted along the sternum to the base of the heart. A præsystolic thrill may be present. Mitral stenosis has been observed in association with this lesion, and two præsystolic murmurs may be made out in such cases.

The physical signs and the diagnosis of *combined valve-lesions* remain to be described. The mitral and aortic valves may each be affected with stenosis and insufficiency, from a single attack of endocarditis, or from one lesion arising as a consequence of the other. The double aortic murmur, already described, indicates the aortic combination; but it must be always remarked that the systolic murmur in these cases may exist with little or no actual stenosis.

In the double form of mitral disease, either defect may exist alone at first, and afterwards be associated with the signs of the second. In some cases the præsystolic murmur may fail to be heard, and a systolic murmur may alone be audible; in other cases, there is a prolonged apex-murmur which slightly changes tone; in other cases, again, a short grinding præsystolic murmur is followed, occasionally at an interval, by a soft, blowing, systolic one. The combination of aortic with mitral disease may be recognised by the presence of their special murmurs.

PROGNOSIS.—It is very difficult to state general rules of prognosis in valvular affections of the heart, as so much depends on the peculiarities of each case. There are, nevertheless, certain broad rules. As regards origin, rheumatic inflammation is less serious than degenerative change, which occurs later in life, and is necessarily progressive. Accidental rupture is the gravest form of origin. The valve affected is also a prognostic element; but any attempt to arrange cases in order, according to the seat of the valvular defect, must be open to so many exceptions that it must not be too much trusted. Speaking generally, however, tricuspid lesions are gravest, mitral less so, and aortic—especially aortic stenosis—probably least so. When the heart fails, and asystole supervenes, the prognosis is worse, however, in aortic cases than in mitral.

Aortic cases are often free for years from any grave symptoms. When the murmur is conducted to the left apex, the prognosis is more favourable, as, the aortic segment affected being non-coronary, the muscle of the heart is not robbed of its blood. The presence of the second sound over the carotids is favourable. The pulse-tracing also affords valuable aid in prognosis, as it gives, by the size of the dicrotic wave and the obliquity of the line of descent, a rough measure of the amount of insufficiency. There is much more risk of sudden death in aortic cases than in mitral.

In mitral lesions the dangers arise from the pulmonary complications; embolism is more common than in aortic affections. Mitral cases can be rescued from asystole more frequently, and die of advanced cardiac cachexia, generally with dropsy. Under favourable conditions of life, requiring little physical exercise and causing no emotional excitement, both forms of mitral disease are compatible with many years of life. When they are conjoined, the prognosis is more unfavourable. In cases of sudden insufficiency, produced by rupture of the valve-curtains or of the tendinous cords, death may occur very rapidly from the disturbance of the circulation.

The whole question of prognosis turns principally on the state of the myocardium. So long as this is sound, compensation may be maintained; the moment degeneration sets in, asystoly and all its evil train of symptoms come on. Thus asystoly coming on gradually, without any previous overstrain of the heart, is always most grave. Each successive attack becomes graver, and the visceral congestions which accompany it more stubborn. Albuminuria is a marked index of the gravity of the congestion, and is serious in proportion to the frequency with which it has occurred. In some cases a copious flow of limpid urine is a very grave symptom. Dropsy of the extremities, and of the cavities more especially, is bad, as indicating failure in the peripheral circulation. Next to the cardiac muscle, the state of the peripheral vessels is most important; thus, petechiæ are bad signs; while atheroma and other conditions, such as febrile attacks, add to the danger by interfering with the circulation. The general nutrition of the patient suffering from valvular disease also enters into the prognostic problem. There is a cachexia proper to the end of heart-cases, which is due to the gradual deterioration of the nutritive fluids by the long-continued visceral congestions which hinder assimilation and excretion. Blood is less perfectly made and less perfectly purified; hence the steady deterioration of cardiac cachexia, which is always of evil import as regards duration of life. Valvular diseases are, however, in numerous instances compatible with many years of life—aortic in fairly active, mitral in sedentary persons. In some the healthy expectation of life may be attained; and, in many, years of comparatively active life are enjoyed. In the poor, the prognosis, as to duration, is not favourable; but in the well-to-do, all observers see many cases extending over a great number of years.

TREATMENT.—Valvular affections of the heart, whether the result of rheumatic inflammation or of degenerative change, are, as a rule, incurable. Some few cases of rheumatic origin lose the signs of valvular disease, and are practically restored by the after-processes (for example, contraction) in the inflamed valve; and some few cases also of mitral insufficiency, associated with dilated left ventricle and softened muscle, are cured by treatment. These exceptions are, however, few; and as we cannot repair the valve-mischief, in the vast majority of cases, our treatment must be directed to aid the compensatory hypertrophy, and to check the development of the consequences of the defect. The maintenance of the nutrition of the substance of the heart is, therefore, the main object of treatment; just as the state of the nutrition of the heart is the key to the prognosis. On this account the general regimen of heart-cases is very important.

General regimen.—The diet should in all cases of valvular disease of the heart be unstimulating but sustaining, consisting of a good proportion of albuminous food (underdone meat, eggs, poultry, and fish), with wine in moderate quantity, and some chalybeate water. There should be no unnecessary excitement of the heart, either by exercise or emotion. All athletics and violent efforts should be avoided by the young, especially in mitral cases. In aortic cases, steady exercise without strain is beneficial. The residence should be so situated as to avoid the necessity of exertion, sudden changes of temperature, cold, and damp. The chief object of the regimen should be to prevent anæmia; hence plenty of fresh air is essential. Tobacco is injurious. In early life over-exertion and exposure to cold—in adult life, emotional, sensual, and dietetic excesses are the chief dangers. The propriety of marriage must be considered in each case on its merits. Women, as a rule, should not marry; when affected with mitral disease they are often barren. To men marriage is more generally permissible.

Medicinal treatment.—The therapeutical treatment varies according to the stage of the cardiac disease. The mechanical defect of a valve first makes itself felt by palpitation and præcordial pain; these symptoms pass away when compensation is effected, but till then require treatment. In cases of mitral disease, tincture of digitalis (♏ x doses) relieves the palpitation; chloric ether is also a useful adjunct. In aortic cases, ether, diffusible stimulants, small doses of opium and belladonna, with the local application of belladonna to the præcordial region, are valuable remedies.

The præcordial pain, mostly retro-sternal, may, when severe, require a few leeches or cupping, but generally yields to mild counter-irritants, such as turpentine, iodine, or mustard. Internally the bromides are useful; when the pain occurs paroxysmally, ethereal preparations and ammonia act well.

When the compensatory changes in the heart are effected, the palpitation and pain decline, and the chief indication is to keep up the nutrition of the heart by the hygienic rules above given, and by the administration of preparations of iron, combined with arsenic, strychnine, quinine, and mineral acids. Chalybeate waters are also useful adjuncts. The syrup, infusion, and tincture of the prunus virginica, are preparations of value in some cases after the use of digitalis. The secretions should be carefully watched, and the bowels opened freely every day, so as to avoid straining, and to relieve the portal circulation. The quantity of urine should be daily noticed, as it is a capital index of the state of arterial tension. Patients in whom the most perfect compensation exists are, nevertheless, in a state of imminent trouble, for an exaggeration of a physiological act or emotion may disturb the unstable equilibrium of their health. In most cases the compensation breaks down sooner or later; and then begin the symptoms depending on pulmonary congestion and general visceral engorgement, with the consequent impoverishment of the blood. Dyspnœa marks the beginning of these troubles; anæmia and dropsy the close. The pulmonary congestion soon manifests itself by bronchial catarrh, which requires expectorants in various combinations, while friction, poultices, and counter-irritation are applied to the chest-walls. In capillary bronchitis with rapid pulmonary congestion, it is sometimes necessary to bleed from the arm to relieve the over-distended cavities of the right side of the heart. Nauseating doses of ipecacuanha, or actual emetics of sulphate of zinc, are sometimes very useful.

For the general visceral congestions our chief remedies are, firstly, diuretics; and, failing these, hydragogue cathartics. Of diuretics, the salts of potassium, digitalis, squill, broom, chimaphila, spirit of nitrous ether, and juniper are the most useful. The hydragogue cathartics, which relieve the over-distended portal vessels primarily, and the general circulation secondarily, are also most valuable: of these the compound powders of scammony and jalap in 20- to 40-grain doses; bitartrate of potassium in electuary, one to two drachms, every morning; sulphate of magnesium; compound scammony pill; elaterin; senna; and gamboge are the most trustworthy. By the judicious use of an occasional purgative, and the administration of a suitable diuretic, aided by cupping, poultices, and sometimes a small blister over the loins, combined with rest and stimulants, the worst cases of dropsy from cardiac failure are often saved.

For the dyspnœa and the insomnia, two of the worst symptoms, we have a remedy of great power in the subcutaneous injection of morphine in doses of one-sixth of a grain upwards. This remedy acts often like a charm, and may be used even in the worst cases of both mitral and aortic disease, but always with caution. Albumen in the urine does not necessarily contra-indicate its use. In some cases chloral hydrate and bromide of potassium, alone or in combination, are valuable remedies for the insomnia; of new remedies, urethan and sulphonal are the best; paraldehyde is also useful; but they must all be given cautiously. The bromides may be prescribed with other sedatives such as nitroglycerine for the dyspnœa. The compressed-air bath also relieves the last symptom.

Dropsy, like the visceral congestions with which it is associated, requires the use of diuretics and hydragogue cathartics. When these fail, the swollen limbs may be punctured with benefit. Continued friction of the limbs, by stimulating the vessels, will often cause considerable anasarca to disappear. The drug on which main reliance must be placed when general dropsy supervenes is digitalis. It is *par excellence* the cardiac tonic. Convallaria, strophanthus, casca, caffeine, and adonis vernalis are other drugs having similar action—strengthening, but slowing, heart-beat. They are all less trustworthy than digitalis. Caffeine is a good diuretic, and so occasionally is convallaria, even when digitalis has failed. Strophanthus is generally the most useful. Digitalis has so great a share in the therapeutics of heart-disease, and a knowledge of its action is so important, that it must be discussed separately and last. Whatever views may be held as to its physiological action, its greatest triumphs are seen clinically in the treatment of valvular diseases, when cyanosis, distended jugulars, dyspnœa, congested viscera, dropsical limbs, scanty urine, tumultuous heart-action, and quick, irregular, and failing pulse, indicate asystole. This assemblage of symptoms is mostly seen in mitral cases, and it is precisely in this class that the drug is most valuable. Under its use 'the pulse grows in force, fulness, and regularity; the arterial tension rises; the pulmonary congestion diminishes; the kidneys, before inactive, wake up to their work; and the advancing dropsy recognises its master and beats a sullen retreat.' In mitral stenosis these good results are due not only to the increased vigour given by the drug to the contractile power of the heart, but also to the fact that by its slowing action the diastolic period of each revolution is lengthened, and the time thus increased during which the distended auricle can force its contents through the narrowed mitral orifice into the left ventricle. Digitalis here not only obtains a better filling of the ventricle, but a more effective discharge of its contents when filled: and thus, under its use, beat by beat, the general and pulmonary venous congestion is relieved. In mitral insufficiency it is almost equally potent. In both forms certain of its good effects would seem to be due to some influence, probably through the pneumogastric nerves, in producing contraction of the pulmonary blood-vessels. It is perhaps this property which makes it valuable in pulmonary hæmorrhages, independent of heart-disease.

In aortic valvular diseases digitalis is not so valuable a remedy. In these cases the assemblage of symptoms mentioned above is not met with, except sometimes in the later stages, when the mitral valve is secondarily affected, and the case is not one of pure aortic disease. In these compound cases the drug is valuable, especially in combination with stimulants. In aortic insufficiency alone, the slowing action of the digitalis produces evil by increasing the length of the diastolic period of each revolution, during which the regurgitation takes place. The force it may give to the systole is no gain in the face of this slowing action, inasmuch as the aortic recoil gains in the same proportion as the ventricular systole, and thus forces blood back into the ventricle with increased vigour during the lengthened diastole. It is important in aortic insufficiency to maintain the frequency of the cardiac action; hence these cases are so constantly the better for bodily activity; and so, when the toning effects of digitalis are required, it should always be given in combination with ether and ammonia, to keep up quick action of the heart, and to prevent the vertigo and syncope which may otherwise occur. When there is excessive hypertrophy in cases of aortic insufficiency, digitalis is useful sometimes in quieting palpitation, reducing excessive frequency, and lessening headache and vascular excitement. Caffeine given with senega, aconite in small doses, and veratrum viride also relieve these symptoms; but a few drops of nitrite of amyl inhaled from cotton-wool, or nitroglycerine tablets, are more rapidly and surely beneficial than any other remedy. In aortic stenosis digitalis is rarely required. The simple mode of compensation makes these cases require little treatment. Digitalis is sometimes useful in combination with stimulants to give vigour to the myocardium, and check the tendency to dilatation. If it slows the action of the heart notably, its effect becomes hurtful. Nux vomica often prevents this.

In combined valvular lesions, the predominant lesion must be the guide in the use of digitalis; but it may be given advantageously whenever the general signs of venous stasis are present. The diuretic power of the drug is one of the best tests of its beneficial action. Relying on this test, the writer often gives digitalis for weeks, nay, months at a time, and obtains improvement in the nutrition of the heart which lasts long after its discontinuance. Digitalis effects this improvement by increasing the vigour of the coronary circulation, and thus builds up new heart-muscle to compensate a valvular defect. In aortic cases the nutrition of the muscle must be kept up by iron, arsenic, quinine, strychnine, and stimulants.

The preparations of digitalis which may be used are, the powder in ½ to 1 grain; the tincture in ♏v to xxx; and the infusion in ʒj to ʒvj doses. As a diuretic in cases of dropsy, the old combination of squill, digitalis, and blue pill is invaluable.

B. Walter Foster.

HEART, Valves of, Aneurysm of.—Definition.—A valvular aneurysm is a circumscribed pouching or sacculation of one of the valve-segments.

Description.—Two forms of aneurysm of the valves of the heart are met with. In the one, the whole thickness of the valve is dilated by the blood-pressure to form the pouch; in the other, one of the lamellæ being ulcerated by endocarditis, the blood pushes the remaining lamella before it to form a sac. The second form, which is sometimes called 'acute valvular aneurysm,' occurs most commonly in ulcerative endocarditis. Valvular aneurysms vary in size from a pea up to a pigeon's egg. The orifice is almost invariably towards the greatest blood-pressure—those on the mitral valve opening towards the left ventricle, those on the aortic valves towards the aorta. They are usually rounded in shape, but may have irregular prolongations between the lamellæ of the valves. Valvular aneurysms are sometimes multiple. The valves of the right side of the heart are seldom affected. The mitral valves are the seat of the larger aneurysms, and are twice as often aneurysmal as the aortic valves.

Valvular aneurysms terminate commonly by early rupture, giving rise to perforation and consequent insufficiency of the valve, and often leading to considerable laceration. Rupture occurs more rapidly in aneurysm of the aortic valves. Mitral aneurysms occasionally become chronic, and filled with coagulum; and aortic valve aneurysm may also be found filled with solid clot.

Symptoms.—The clinical history of this form of disease is defective. When seated on the mitral valve, aneurysms usually give rise to no signs until the perforation and laceration of the valve suddenly develop the murmur of mitral insufficiency. An aneurysm of one of the aortic segments causes a soft systolic murmur over the valves, which one day, as the sac ruptures, is supplemented by a diastolic murmur, and accompanied by the symptoms of aortic insufficiency. The phenomena of this accident are similar to those of sudden rupture of an aortic valve.

B. Walter Foster.

HEART, Wounds of.—Synon.: Fr. *Blessures du Cœur*; Ger. *Herzwunden.*

The subject of wounds and other injuries of the heart belongs more properly to the domain of Surgery, but, being in several respects of much medical interest, it requires to be briefly discussed here.

Ætiology and Anatomical Characters.—Wounds of the heart may be punctured, incised, or lacerated; and inflicted with a variety of weapons or other sharp bodies, as well as with projectiles, especially bullets. Traumatic ruptures and contusions form another considerable class of injuries of the heart, which chiefly result from falls, crushing accidents (for example, being 'run over'), kicks, and blows. Injuries of the heart due to the entrance of foreign bodies, such as a needle or a bone, may be inflicted in some rare cases from the interior of the œsophagus or stomach; the most remarkable case of this kind being one of wound of the pericardium from behind by the point of a sword which a juggler had attempted to 'swallow.'

Post mortem, the chest-wall generally presents evidence of the wound that has been inflicted. The pericardium rarely escapes injury. Its sac is found to contain blood in recent cases, or effused lymph or pus when life has been preserved for a few days or more. The walls of the heart at the seat of injury present different appearances, according to the precise nature of the lesion. Punctured and incised wounds may be of all sizes; may take either a direct or an oblique direction through the muscular fibres; and are generally penetrating. Bullet-wounds cut away a portion of the heart, whether at the borders or from the thickness of the organ. Traumatic ruptures present special characters (*see* HEART, Rupture of). In all the varieties of injury of the heart, the wound is found plugged with blood-clot, the edges being either infiltrated or ecchymosed and torn. In cases that do not prove rapidly fatal, the usual signs of inflammation, or healing, and even cicatrisation, are found in the heart; or aneurysm of the cardiac walls may be developed as a result of the latter. The valves and their appendages are frequently incised or otherwise injured. In some cases a portion of the weapon, projectile, or foreign body may be found in the heart. The ventricles—and especially the right ventricle—are the parts of the heart most commonly injured. The great vessels, lungs, and the arteries of the chest-wall, may also be wounded in different instances.

It must be observed that a blow over the heart has proved instantly fatal without leaving any lesion discoverable *post mortem.*

From these results it is evident that wounds of the heart may prove rapidly fatal by loss of blood, by compression of the heart resulting from hæmorrhage into the pericardium, or by shock; whilst, at a later stage, pericarditis, myocarditis, and secondary hæmorrhage may be expected to supervene.

SYMPTOMS, COURSE, AND TERMINATIONS.—In about one-third of recorded cases of injury of the heart, either death is immediate—fainting, convulsions, and the other symptoms of syncope, as well as those of shock, being the prominent phenomena, along with external hæmorrhage; or the patient drops dead after a few moments, during which time he may have undergone considerable exertion. In a second class of cases, the symptoms of syncope or of shock occur immediately, but death does not ensue at once. The patient then lies in a state either of unconsciousness or of complete prostration. In the latter event he complains of a sense of great debility, præcordial oppression, dyspnœa, and suffocation; the surface is cold, pallid, and trembling; vomiting may occur; and there is usually hæmorrhage from the region of the heart. Death occurs after minutes or hours, either from exhaustion due chiefly to continued or repeated loss of blood, or from compression of the heart. In a third series of cases, the course is more protracted. The patient, after suffering from the symptoms just enumerated, but in a less degree, passes through the various phases of constitutional disturbance commonly observed in severe wounds, complicated, however, with pericarditis, myocarditis, and repeated hæmorrhage; and dies of exhaustion after an illness of weeks or months. Lastly, in a small proportion of cases, the patient survives the various accidents and complications just described, and the wound of the heart heals; but it sometimes happens that symptoms of aneurysm of the cardiac walls, or of incompetence of the valvular apparatus, are developed as the result of the lesion.

DIAGNOSIS.—Wounds of the heart can usually be diagnosed without difficulty by the situation of the external injury, and the severity of the symptoms. Similar symptoms may, however, follow injuries of the great vessels in the neighbourhood of the heart, or of the arteries of the walls of the chest, if the hæmorrhage be profuse; still, unless there be almost complete certainty that a vessel within reach is the only seat of the bleeding, the diagnosis should be left undecided, and all dangerous interference avoided.

PROGNOSIS.—Injury of the heart is generally to be regarded as certain to end in death; but it should not be forgotten that as many as 12 per cent. of recorded cases are said to have recovered. Some very remarkable instances have occurred of recovery after very severe injury to this organ; for example, a case in which a bullet was lodged in the substance of the heart for twenty years (*Brit. Med. Journ.*, March 23, 1867). The prognosis may be broadly estimated by the severity of the immediate symptoms. Traumatic rupture of the heart is said to have invariably proved fatal.

TREATMENT.—In wounds of the heart, the hæmorrhage must be at once arrested by the usual surgical means; immediate death must be prevented by cautious stimulation; and the patient must be kept in such a condition that, whilst life is preserved, the danger of inflammatory reaction in the region of the heart, and of fresh hæmorrhage, is reduced to a minimum. It is on this account that restorative measures are to be guardedly employed at first, and resorted to in the further progress of the case only when urgently indicated. Absolute rest of body and mind is indispensable. Nervine and cardiac sedatives, such as bromide of potassium, morphine, chloral-hydrate, and belladonna, may be of great service when used with judgment.

J. MITCHELL BRUCE.

HEARTBURN.—SYNON.: Cardialgia.—Heartburn is a hot or scalding sensation, usually referred to the cardiac orifice of the stomach, but in some cases diffused over the whole abdomen. It is a marked symptom of indigestion, and is frequently accompanied by eructations of a very acid character; and the fluid rejected from the stomach produces a sensation of scalding in the throat and œsophagus.

ÆTIOLOGY.—Heartburn exists in a very marked degree in dilatation of the stomach, being produced by the decomposition of indigestible food retained in this organ. It constantly accompanies chronic catarrhal gastritis, the retained mucus enclosing particles of food in a state of decomposition, which set up fermentation in the materials of each meal as soon as it is swallowed. Heartburn is common in the later period of pregnancy, probably because the stomach is so displaced that it is unable properly to expel its contents.

TREATMENT.—This sensation is best treated by antacids, such as chalk, magnesia, alkalis, and alkaline waters. Aperients and alteratives may be necessary. In some cases powdered charcoal relieves it. The diet also requires careful regulation. All articles of food containing much fat, sugar, or starch, should be avoided. The use of tobacco should be interdicted; the writer has frequently seen obstinate cases kept up by smoking and chewing. Alcoholic stimulants should be used very sparingly, the least likely to do harm being brandy mixed with Vichy or potass water. The writer has obtained good results by substituting gluten bread for the ordinary baker's bread; and, where this could not be taken, has found advantage from the use of aërated or some other kind of unfermented bread. Some women who suffer severely from heartburn when pregnant find relief from eating lettuce. S. FENWICK.

HEART-CLOTS.—*See* HEART, Thrombosis of.

HEAT, Ætiology of. — *See* DISEASE, Causes of; and the following article.

HEAT, Effects of Severe or Extreme.—(*A*) Constitutional Effects of Severe Heat acting generally.—The constitutional or general effects of exposure of the whole body to high temperatures vary with the source and degree of heat, the slowness or rapidity of transition from lower temperatures, and the length of exposure, as well as with the age, constitution, habit and health of the body; and they are liable to be more or less modified or obscured by various concomitant circumstances and conditions, such as the barometric pressure, the hygrometric state, and the purity or impurity of the atmosphere.

The range of temperature within the limits of which life can be maintained appears to be greater in the case of man than in that of most of the lower animals, in virtue of greater power of accommodation to external influences, without undue elevation or lowering of the temperature of the body. But in every case any such combination of external circumstances as causes the temperature of the body to rise 10° to 15° above the normal standard speedily proves fatal.

1. **Artificial heat.**—Numerous observations and experiments show that in *dry air* exposure to very high temperatures can be borne, during periods varying with circumstances, without danger or even serious inconvenience, the temperature of the body being kept down within safe limits by evaporation from the surface and from the lungs. Thus, in Dobson's experiments, a temperature of 210° was sustained during twenty minutes; Blagden exposed himself during eight minutes to a temperature of 260°; Chantrey's workmen were accustomed to enter a drying oven in which the thermometer stood at 350°; and Chabert, the 'Fire King,' is said to have frequently exposed himself to a temperature of from 400° to 600°. Glass-workers, metal-founders, gas-stokers, engineers in steam-boats—especially in the tropics—bakers' oven-builders, and others constantly carry on their work in temperatures of from 120° to 160° or even higher—to say nothing of the blasts of radiant heat to which some are from time to time exposed. In *moist air*, evaporation from the surface and its cooling influence being diminished or prevented, much lower temperatures speedily become insupportable. Berger was unable to remain in a vapour bath the temperature of which had risen from 106° to 120°, although he had easily borne a temperature of 230° in dry air for five minutes. When the natural loss of heat is prevented by the moisture of a hot atmosphere—as in a vapour bath, or by immersion in a hot-water bath, or otherwise—the temperature of the body rises. It has been found, taken in the rectum, to rise as high as 103° in eight minutes, and even to 107° (?) in thirty minutes in a vapour bath of 127° (Bartels); and in a hot-water bath of 104° to 111° the temperature taken in the mouth has been found to rise to 101·6° (Mosler).[1]

Dr. Fleming[2] found that exposure in the Turkish bath during an hour to a temperature commencing at 170° and gradually lowered to about 130°, caused the temperature of his body (taken by a specially devised thermometer in the mouth) to rise rapidly during the first ten minutes from a normal average of 97·65° to 99·2° (a rise of 1·55°); and then more slowly until the end of fifty minutes, when the highest point, 101·3° (a rise of 3·65°) was reached. His pulse rose during the first ten minutes from 78 to 91 beats in the minute, and like the temperature attained its maximum, 115, at the end of fifty minutes. His breathing first diminished in rapidity from 22·5 to 20·8, and then increased to 25·4 in actual rapidity, but maintained a diminished ratio to the pulse. The arterial tension seemed to be increased by the greater rapidity of the heart's action, combined with the gorged state of the capillary circulation. The quantity of material eliminated during the hour amounted to forty-four ounces. The proportion of chlorides in the urine passed after the bath (3·65 in the 1,000) was little more than half that in the sweat (6·05) collected during the bath, and much less than in the urine previously passed (5·68). The proportion of urea in the urine was slightly increased, and the sweat contained 1·55 in the 1,000.

---

[1] Leichtenstein. *General Balneotherapeutics.* Smith, Elder & Co., 1885.

[2] *Journal of Anatomy and Physiology,* July 1879.

The effects felt by those exposed to great heat vary with the temperature, the length of exposure, and collateral circumstances, such as impure atmosphere, physical exertion, &c. A sensation of warmth, at first agreeable, is succeeded by one of oppressive and then painful heat, until this is again relieved by the establishment of copious evaporation from the surface. Pleasant stimulation, and some degree of excitement of the nervous and muscular systems, are quickly followed by languor, lassitude, listlessness, feelings of exhaustion, indisposition to mental effort or muscular exertion, dizziness, tendency to sleep, faintness and unconsciousness, sometimes accompanied or preceded by convulsions. If relief is not afforded death ensues. If timely relief is afforded, more or less speedy and complete recovery may be brought about.

If the symptoms have been severe and persistent, or if the sufferer has been exposed to repeated attacks, permanent damage to the health, and especially to the nervous system, almost certainly results, in spite of apparent temporary recovery. In many cases general debility and deterioration, in some cardiac troubles, and in others insanity, have been recorded as the persistent after-effects. Symptoms and conditions closely or exactly resembling those of sunstroke, may be produced by exposure to an artificially heated atmosphere, or to blasts of radiant heat from fires or furnaces. *See* SUNSTROKE.

Bernard, Delaroche, and others have shown that animals exposed to temperatures of from 130° or lower, to 150° and upwards, quickly die.

The *post-mortem* examination of animals so killed showed that the heart had entirely ceased to beat at the moment of death, and that neither it nor the muscular coat of the intestines could by any means be stimulated to contract again. The muscular fibres of the heart examined microscopically appeared rigid and coagulated (Kühne and Ranvier). Further, the blood in both arteries and veins was dark coloured. *Rigor mortis* set in very early, and general decomposition very speedily commenced. It would thus appear that (apart from sudden shock to the system generally) *the cause of death* from exposure to high temperatures is to be found in the effect produced on the muscular system of organic life, and especially on the heart. The cardiac myosin coagulates at 115°; and at a temperature considerably short of this its condition must be seriously affected.

ANATOMICAL CHARACTERS. — The *post-mortem* appearances met with in the human subject in cases in which death has been attributed to the general effects of heat have not been uniform, probably because there has been in most cases simultaneous exposure to other deleterious influences. The following case, however, recorded by C. Speck[1] is noteworthy. A girl, æt. fourteen, the subject of chronic disease of many of her joints, was, on the advice of a quack, wrapped in a sheepskin warm from the carcass, laid in bed, surrounded with hot loaves fresh from the oven, and covered by the clothes. In about an hour she complained of pains, especially in one arm. She soon feel asleep. It was noticed that her chest rose and fell strongly. She perspired freely, and the sweat was frequently wiped off. She became very pale, and about three hours after the commencement of the treatment she expired, without having recovered, or at any rate manifested, consciousness. On *post mortem* examination the next day (the weather being cool and dry) advanced decomposition was found; the blood being black and fluid, and the blood-vessels, cavities, and tissues generally full of gas. The heat of loaves fresh from the oven, such as were put round the child, was found to be 185°.

TREATMENT.—The *immediate treatment* to be adopted in the case of those suffering from exposure of the whole body to heat consists essentially in removal into a cooler and purer atmosphere; quiet rest in the recumbent position; fanning; cool or even cold affusions or sponging, especially over the head and spine—the effect, however, being carefully watched; and the administration of cool or lukewarm fluid in small quantity at a time, with some stimulant. Copious draughts of cold water in a highly heated state of body are liable to give rise to dangerous or even fatal results. Bleeding is not to be recommended.

The *after-treatment* must be conducted on general principles, and determined by the condition of the patient, and the indications afforded in the particular case.

2. **Climatic and Solar Heat.**—The effects of climatic heat experienced on transition from temperate to tropical regions are as follows: 1st. The average temperature of the body rises ·5° to 1° according to Davy and Crombie, or to a somewhat greater extent according to others. The daily fluctuations of bodily temperaturo in health in India correspond to those in England. The normal temperature of native Indians is about half a degree higher than that of Europeans (Crombie). 2nd. The pulse is quickened according to most observers, but Rattray says this is incorrect. 3rd. The breathing becomes slower and less deep, falling from about sixteen to about twelve or thirteen per minute. Less carbonic acid and less water

---

[1] *Vierteljahrschrift für gerichtliche Medicin*, 1874, p. 249.

are thus exhaled. 4th. The skin acts much more freely, its excretion being increased by about 24 per cent. (Rattray). The continued hyperæmia and over-action of the skin, however, are liable to be followed by congestion and obstruction of the sweat follicles, giving rise to 'prickly heat.' 5th. The urine is diminished in quantity, and in amount of urea and chlorides. The experiments of Becher (confirmed by those of Forbes Watson) showed a constant relation between the temperature, and the urea and chloride of sodium got rid of by the kidneys. As the temperature rose from 50° to 70°, an increase was found; but with a further rise from 70° to 90°, an almost equally constant diminution occurred. 6th. The appetite, especially for animal food, is diminished, and the digestive powers seem lowered. 7th. Lassitude, languor, want of vigour, indisposition to exertion, and a sense of exhaustion of mind and body are experienced in degrees varying with circumstances; the depressing effects being most felt when the heat is not only great but continuous day and night, and when the atmosphere is moist.

The effects of the radiant heat of the sun, as distinguished from those of atmospheric heat, are not well made out. It would appear probable, however, that a physiological effect adverse to perspiration is produced by the direct rays (Parkes), and that thus, as well as from rapid evaporation, the skin becomes dry, and liable to certain structural changes, such as the formation of pigment.

Exposure to the direct rays of the sun, or to great or continued heat in the shade, especially under unfavourable atmospheric and general conditions, may give rise to heat-fever, heat-apoplexy, or one or other of the forms of sunstroke. *See* SUNSTROKE.

(*B*) **Local Effects of Severe Artificial Heat: Burns and Scalds.**—The local effects of heat vary with the degree, the length of exposure, the medium of application, and the part acted upon. *Burns* result from 'dry,' *Scalds* from 'moist' heat.

SIGNS AND SYMPTOMS.—First: a comparatively slight degree of heat causes vascular turgescence, redness, tingling, pain, and tenderness, which soon subside. Desquamation of the epidermis may follow, but no permanent trace of injury is left. Secondly: a higher degree causes severe burning pain, and great redness of surface, followed by effusion of serum beneath the cuticle (vesication). Complete restoration without scar is usually effected. Thirdly: still higher degrees of heat or longer exposure cause intense pain, and immediate destruction, or consecutive destructive inflammation, of the true skin to a greater or less depth. Sloughing and suppuration follow, and permanent scarring results. Fourthly: violent heat and prolonged exposure cause complete disintegration and charring of the structures especially acted upon, followed by destructive inflammation and sloughing of others to a still greater depth and extent. Loss of parts and more or less serious deformity and scarring necessarily result.

The separation of sloughs, and the processes of repair after severe burns, take place slowly; and as a rule the patient suffers much more acutely, and during a much longer period, than after other forms of injury involving equally extensive destruction of tissue.

The *constitutional symptoms and effects* associated with burns and scalds vary with the superficial extent and situation, rather than with the depth of the injury. Thus an extensive burn or scald over the abdomen affecting only the skin is much more likely to prove fatal than a deep burn of one of the extremities, penetrating even to the bone, but of comparatively small superficial area; and burns over the front of the abdomen or chest are more likely to prove fatal than those of similar extent over the back. If more than half the surface of the body is affected the sufferer rarely recovers.

In severe cases death may result from shock to the system, either immediately on receipt of the injury, or after a period of from two or three to forty-eight hours or more. During such time the sufferer remains in a state of collapse or prostration, with pallor of complexion, lowness of temperature (dependent probably on decreased production of heat), coolness of breath, small or imperceptible pulse, dryness of tongue and mouth, and sometimes delirium, rigors, or convulsions. In about half the fatal cases of burns death is attributable to shock. In such cases, *post-mortem* examination shows only congestion of the viscera, and especially of the brain. In some instances, however, characterised by painfully laboured and frequent efforts at respiration, tumultuous, irregular, feeble, and very frequent action of the heart, and great præcordial distress, death would appear to be due to cardiac thrombosis, rather than to simple nervous shock (Brown). In many severe cases the blood has been found on microscopical examination changed in appearance, the red corpuscles being altered in form, or separated into 'numerous little bits' (Ponfick and Schmidt). And it is readily conceivable that such destruction of corpuscles may cause thrombosis and stasis in various organs, especially in the smaller branches of the pulmonary artery (Silbermann), and so give rise to severe symptoms, and even lead on to death.

In about forty-eight hours, more or less, if the immediate effects of the injury have been survived, the stage of reaction and inflammation sets in. The patient revives, and some degree of general pyrexia becomes manifest. The pulse becomes quicker and fuller; the temperature rises; and the burnt part begins to discharge pus, usually of an offensive odour. Thirst, with dry red tongue, want of appetite, vomiting and constipation, followed by diarrhœa—sometimes with blood in the evacuations — are commonly experienced during the ensuing period; and inflammation of internal parts often occurs, although the special signs and symptoms afforded may be obscure. The pleuræ and lungs, the peritoneum, and the gastro-intestinal mucous membrane (particularly that of the duodenum) are especially liable to be affected. Evidence of inflammation of one or more of these parts, and not uncommonly of ulceration of the duodenum, is afforded on *post-mortem* examination in cases in which death has occurred during this period. It has been suggested that capillary embolism, from the presence of disintegrated blood in the vessels, may cause in some cases the lesions of the internal organs (Brown). During this period, and from the causes indicated, death occurs in about 30 per cent. of the fatal cases.

In the course of about a fortnight or so under appropriate treatment, as a general rule, the acute symptoms will have subsided, the sloughs will have separated, and granulation and suppuration will have become established and healing will gradually take place. But a low form of chronic inflammatory mischief in the internal organs may still be going on, and lead to a fatal result sooner or later; or the patient may sink, worn out by suffering, and exhausted by the profuse discharge from the suppurating surface, or by persistent diarrhœa, accompanied or not by blood in the motions. Sometimes the kidneys are affected, and blood or bloody casts may be found in the urine. Pyæmia, erysipelas, or tetanus may occur and cause death; but there would not appear to be any special liability to these diseases after burns or scalds.

TREATMENT. — *Local treatment.* — Slight superficial burns of small extent require little in the way of treatment. Immersion in cold water according to some, in hot water according to others, or exposure before the fire, affords the readiest means of obtaining immediate relief. Afterwards the part may be covered with flour, starch, oxide of zinc, bismuth, or collodion, and wrapped round with cotton-wool to protect it from the air and from accidental irritation. In cases in which there is vesication, the blisters should be pricked, the serum evacuated, and the cuticle left to form a natural protective covering, which may be advantageously strengthened and kept in position by a layer of collodion. But the punctures should be left open. Lint soaked in oil, or smeared with vaseline or some such material, should be applied, and the whole covered with cotton-wool. A mixture of chalk or whitening and vinegar, of the consistence of thick cream, is said to form an excellent application in such cases, speedily relieving pain, and helping to constitute a good protective covering.

Severe and extensive burns and scalds demand in their treatment the most careful management, and the greatest possible patience, gentleness, and firmness; for even if life be preserved, the most pitiable disfigurements and deformities are liable to result from cicatricial contractions, unless proper preventive measures are perseveringly carried out.

So soon as may be after the injury, the clothes should be removed from the patient with the greatest care — being cut away piecemeal if needful, and not removed in such way as to tear off epidermis or scorched or charred parts. The whole burnt surface, having been cleansed as seems needful by some antiseptic wash or spray, should then be covered as quickly as possible with the dressing considered best, and enveloped in thick layers of antiseptic cotton-wool lightly bandaged on. For cleansing wash or spray solutions of borax or carbolic acid (weak), with the addition or previous application of cocaine, are perhaps best. Different dressings have been advocated from time to time. One seems to suit best in some cases, another in others. But antiseptics should always be used. Among the applications variously recommended may be mentioned the old-fashioned favourite in hospital practice—Carron oil, a mixture in equal parts of linseed oil and lime water. Almond oil or olive oil may be substituted for the linseed oil, and iodoform or a little carbolic acid added with advantage. White lead, putty made thin by addition of oil, calamine ointment, carbolised oil, solution of carbonate of sodium, carbolic lotion, flour, and starch, are among the other materials that have been recommended. Among the best probably may be recommended a combination of boric acid and iodoform with vaseline, or glycerine and oil, as a basis. Whatever the material selected, it should be slightly warmed, and applied very thickly spread on separate strips of lint in such way as to facilitate future dressing bit by bit, and so as to avoid extensive exposure of raw surface. The first dressing should be allowed to remain undisturbed as long as possible—until, indeed, the offensiveness of the discharge, or the discomfort of the patient indicates the necessity for its removal. The earlier dressings, however gently carried out, occasion so much suffering to the patient that—in the case of children especially—it is often desirable to administer chloroform or to spray the parts with a 5 per cent. solution of cocaine. Poultices are sometimes useful in aiding the separation of sloughs. In such case boracic lint soaked with warm water forms an excellent substitute for the old linseed-meal poultice. Any needful washing or cleansing is best done by aid of the steam spray-producer, a weak solution of carbolic acid or of borax being used. When suppuration is established, and the surface clean, the application may be varied according to the indications afforded. Calamine or zinc or lead ointment, with or without the addition of some anodyne; and lotions of lead, morphine, and glycerine, or of sulphate of zinc, are amongst those commonly employed. Iodoform, with extract of hemlock and spermaceti ointment, has been strongly recommended as tending to soothe pain, to deodorise the discharge, and favour healing. Exuberant granulations may be treated with nitrate of silver in solution, or by the application of the solid stick. When the granulating surface is in a healthy state, cicatrisation may be very materially expedited by skin-grafting; and in cases in which there is extensive healthy granulating surface, by transplantation of large portions of healthy skin from some adjoining part.

During cicatrisation, and even for some time afterwards, it is of the greatest importance to keep all parts in such position as that there shall be as little deformity as possible from growing together of surfaces, and contraction of scars. This is to be effected or attempted by position, by mechanical apparatus, and by the application of strips of adhesive plaster and bandages in manner determined by the circumstances and conditions in each particular case.

Constitutional treatment.—In the early stages, alcoholic stimulants, or ammonia, and external warmth are especially requisite, and such light nourishment as can be taken. Opiates or other anodynes, as chloral or bromide of potassium, are to be administered according to the indications afforded, for the purpose of allaying pain and soothing the nervous system. When suppuration is established, a full allowance of good nourishing food, with some alcoholic stimulant, should be given, and such tonics as seem most suitable. Small doses of opium at regular intervals often prove very beneficial. The complications that may arise, such as affections of the internal organs, &c., must be treated in accordance with general principles, but all depressing medicines as a rule should be avoided, and if there should be indications of intestinal inflammation great care should be exercised in the administration of aperients.

(*C*) Local Effects of Severe Solar Heat: Sunburn.

See SUNBURN.

ARTHUR E. DURHAM.

HEAT, Therapeutics of.—PRINCIPLES. The primary effect of external heat applied *locally* to the animal body is that of an excitant or stimulant. There occurs redness, with turgescence of the small vessels, in the part to which the heat is applied, along with slight augmentation of temperature, and pain. Increased beyond a certain degree, heat ceases to be a stimulant, its prolonged action causing greater pain, exhaustion, and depression; and, if the action be very intense, it becomes an escharotic.

Experiments have shown that by increased heat the electric currents in the nerves are destroyed. It may therefore be assumed that the nerves become less able to conduct impressions either to or from the brain, and that heat may act as a sedative to painful nerves.

The action of medicines on the system appears to be influenced by temperature. Ringer found that a small dose of veratrine greatly affects the ventricle at a high temperature, but at a low one produces no effect. Brunton and Cash found that the roots of the vagus in the medulla are paralysed by a high temperature. This may explain the observation of Thomas as to the failure of digitalis to act on the pulse in pneumonia with high temperature.

Heat applied generally—that is, to the whole body—produces a number of important physiological effects which are described in the preceding article; and in that on BATHS.

APPLICATIONS AND USES.—Heat is employed in the treatment of disease as a general or local stimulant, a local depressant, a caustic, or a counter-irritant; and that in the form either of *dry* or of *moist* heat.

Dry heat.—The primary exciting and stimulating action of heat may be made available to rouse the nervous and vascular systems. The use of the hot-air bath (Turkish bath) and that of the sand bath are discussed in the article on BATHS. In some parts of the South of France, baths of hot sand (*arena calida*) are used in the treatment of rheumatism, paralysis, and spasm; the sand acting as a stimulant and sudorific. Bottles of hot water are placed in the axillæ, and against the feet and thighs, to restore the circulation, in cases of collapse of the system with coldness of the extremities and great failure of circulation, as in the treatment of collapse from the shock of an injury, or from such diseases as cholera, or of the apparently drowned.

Dry heat may also be applied to the abdomen, in the form of tins or bottles of hot water, or bags of heated salt or sand, to relieve painful spasm and colic. Hot water enclosed in an indiarubber bag is sometimes of service to allay undue irritability of the spinal nerves. The therapeutical application of heat as a counter-irritant will be found described elsewhere. *See* COUNTER-IRRITANTS.

Moist heat.—Heat and moisture together tend to cause relaxation of the tissues, thus removing the tension and pain due to inflammation. Moist heat is employed locally in the form of the local vapour bath, fomentations, and poultices. *See* Fomentations; and Poultices.

Moist heat is applied to the surface of the body generally, chiefly in the form of the vapour bath. *See* Baths.

John C. Thorowgood.

HEAT-STROKE.—A synonym for sunstroke. *See* Sunstroke.

HECTIC FEVER (ἑκτικός, habitual).—Synon.: Fr. *Hectique*; Ger. *Hectisch.*

Ætiology.—The variety of fever thus named has long received special recognition, inasmuch as it presents certain prominent and peculiar features, as regards its course and attendant phenomena. It usually occurs in association with some wasting and exhausting disease, especially when this is accompanied by a profuse and constant drain from the system, and more particularly when there is chronic suppuration, with an abundant discharge of pus. Hectic fever is most frequently noticed in cases of pulmonary phthisis, in a large proportion of which it appears in various degrees during some part of their course, chiefly in the advanced stages. Other conditions deserving of mention in connexion with which it may supervene are empyema, especially if there is an external fistula, tubercular ulceration of the intestines, chronic purulent discharge from the kidneys, hepatic abscess, chronic dysentery, and any form of external chronic abscess attended with an abundant formation of pus. Fever of a hectic type sometimes occurs in cases of acute inflammation; and it is occasionally observed in chronic affections unattended with suppuration, such as cancer and lymphadenoma.

Symptoms.—Hectic fever is usually established gradually, becoming more and more distinct, until it assumes its typical characters. It is more or less paroxysmal, being at first indicated by slight pyrexia towards evening and during the night, the temperature being a little raised, and the pulse hurried. During the day there is no fever at this time, but as the case progresses it becomes constant, though exacerbations occur at night, and, it may be, also in the morning, the paroxysms thus occurring either once or twice within the twenty-four hours, and the pyrexia being remittent. In typical hectic there is a complete febrile cycle, beginning with chills or even a distinct rigor, followed by considerable heat of skin, the temperature continuing to rise, and ending in more or less profuse perspiration, especially about the head and chest, sometimes so abundant as to saturate the bedclothes or even the bedding. Patients often feel subjectively very hot, the palms of the hands and soles of the feet having a burning sensation. The pulse tends to become very frequent and quick, and is easily hurried and excited, being at the same time weak, soft, and compressible. Not uncommonly a bright red or pink spot appears on each cheek during the paroxysm, known as the *hectic flush*, and this may contrast markedly with the general pallor of the face, the eyes being also bright, clear, and sparkling. The mind is unaffected, and the mental faculties may be unusually cheerful and vivid. After a febrile exacerbation the urine may present excess of lithates. Hectic fever does not always show all its typical features, and even in the same case variations are noticed in the precise characters of the paroxysms. It is usually accompanied with other symptoms due to the disease with which it is associated; while it itself tends to cause wasting and debility, as well as a sense of much exhaustion after each attack. In most instances a fatal termination ultimately ensues, but if the condition upon which hectic fever depends is curable, recovery will generally take place.

Treatment.—The first principle in the treatment of hectic fever is to attend to, and cure, if possible, the condition with which it is associated, and especially to diminish or check suppuration, to prevent retention of unhealthy pus, or to employ antiseptic applications. General tonic treatment will also help in preventing the attacks. These may be directly checked in appropriate cases by full doses of quinine, salicine, salicylates, or other antipyretics, given before the usual time for their occurrence. Sponging the skin freely may also prove of service in some instances. The treatment of hectic in phthisis runs into that of night-sweats, and can be more conveniently discussed under that disease. *See* Fever; and Phthisis.

Frederick T. Roberts.

HELIOSIS (ἡλιόω, I expose to the sun). A method of treatment for certain diseases, which consists in exposing the patient to the rays of the sun. The term is also employed as a synonym for sunstroke. *See* Sunstroke.

HELMINTHIASIS (ἕλμινς, a worm). The condition of system upon which the development of worms in any part of the body depends. The term is also applied to diseases characterised by the presence of worms.

HELMINTHICS (ἕλμινς, a worm).—Of or belonging to worms. A synonym for anthelmintics. *See* Anthelmintics.

HELMINTHS (ἕλμινς, a worm).—This term is often employed in preference to one or other of the various synonyms with which it is regarded as equivalent (worms, intestinal worms, vermes, entozoa, internal parasites, and so forth). Thus, von Siebold (who speaks of the Helminths as forming a *class* of animals, nearly all of whose members are parasitic) admits that the only character common to the greater part of the whole group is their peculiar mode of life. The study of the helminths forms what is often called the science of *Helminthology*. It has been thought desirable, in the present work, to speak of the helminths as constituting part of the class Entozoa, under which heading, therefore, more detailed references are given. T. S. Cobbold.

HELOUAN, near Cairo, Egypt.—Thermal sulphurous muriated saline waters. *See* Mineral Waters.

HEMERALOPIA.—Definition.—Day blindness: a disorder of vision in which objects cannot be seen well or comfortably in ordinary daylight or by strong artificial light, but are seen more clearly or more comfortably in shade or in twilight.

Most modern authors use the term in the opposite sense of *night* blindness, regarding it as derived from ἡμέρα, the *day*, and ὤψ, *the eye* or *sight*. In this work it has, from the first, been used in the sense given above, the *al* being regarded as representing *alpha privativa*, or as a contraction of ἀλαός, *blind*. This meaning has since been adopted in the *Nomenclature of Diseases* of the Royal College of Physicians. The word 'hemeralopia' does not occur in any of the genuine ancient Greek or Latin medical writings. It is once mentioned, without being defined, in the pseudo-Galenic treatise, *Introductio seu Medicus* (ed. Kühn, xiv. 768). It has, however, long been used as the antonym of nyctalopia. *See* Nyctalopia.

Causes.—Day blindness is a symptom rather than an idiopathic affection, and is sometimes the effect of mere intolerance of light (photophobia), dependent upon irritation or inflammation of the cornea, &c. The various causes may be grouped as follows:—

1. Opacity in some of the refractive media, such as central nebula or leucoma of the cornea, or circumscribed opacities occupying the pupillary region of the lens or the vitreous. In such cases, vision is obscured when the pupil is contracted, but becomes clearer when the pupil dilates in shade. 2. Irritation or inflammation of the parts of the eye innervated by the sensory fibres of the fifth nerve—the lids, the conjunctiva, the cornea, or the iris; neuropathic affections of these textures; and reflex irritation from nose, teeth, uterus, &c. 3. Hyperæsthesia of the retina, which may be due to reflex irritation, or (rarely) to inflammation of the retina, the optic nerve, or the choroid, to insufficient pigmentation of the ocular fundus as in albinism, to dazzling from coloboma of the iris or preternatural dilatation of the iris from any cause, to exposure to bright lights or glare of any kind, to prolonged seclusion in darkness or dimly lighted places. A transient physiological form of hemeralopia occurs whenever the eyes suddenly pass from darkness into bright light.

Treatment.—The treatment of hemeralopia should follow the special indications. Impairment of sight due to central opacity in any of the refractive media may often be relieved by dilatation of the pupil with a weak solution (gr. $\frac{1}{20}$ to gr. $\frac{1}{2}$ to an ounce) of atropine or other mydriatic, or by making an artificial pupil. Inflammations of the various textures of the eye and reflex irritations are to be treated by appropriate means. The eyes should be protected by a shade or by neutral-tinted glasses. The general treatment must be adapted to the associated local and constitutional conditions.

John Tweedy.

HEMIANÆSTHESIA (ἡμι-, half; ἀ, priv.; and αἰσθάνομαι, I feel).—Paralysis of sensation, affecting one side of the body. *See* Sensation, Disorders of.

HEMIANALGESIA (ἡμι-, half; ἀ, priv.; and ἄλγος, pain).—Insensibility to painful impressions, affecting one side of the body. *See* Sensation, Disorders of.

HEMIANOPIA (ἡμι-, half; ἀ, priv.; and ἄψ, sight).—The term 'hemiopia' is now generally taken to mean loss of perceptive power in one lateral or vertical half of the *retina*; while by hemianopia is understood obscuration of vision on one lateral or vertical half of the *visual field*. Thus, owing to the fact that rays of light cross within the eye, right lateral hemianopia is produced where left lateral hemiopia exists, as a result of intracranial disease of one or other kind.

It is well known that in the lower vertebrate animals the optic nerves undergo a complete decussation at the optic chiasma, so that all impressions from each eye go to the opposite optic lobe. Some believe, even to the present day, that a similarly complete decussation of the optic nerve-fibres takes place at the chiasma in man; others (constituting a large majority) altogether reject this notion, and adopt the view originally propounded by Newton and reinforced by Wollaston, that at the optic chiasma there occurs a semi-decussation only. Neither view can be said to be definitely proved to the exclusion of the other; and it seems quite possible that these discrepancies in doctrine may be in part dependent upon the fact that the course of the optic fibres is not the same in all men. There may, in fact, be variations in the degree of completeness of the decussation of the optic nerve-fibres at the chiasma, just as, from the researches of Flechsig, we now know that not infrequently considerable variations occur in the amount of decussation of motor fibres in the anterior pyramids of the medulla.

The effects resulting from congenital or early blindness of one eye supply us with some information bearing upon this point. Where a semi-decussation exists, the effects of the atrophy of the optic fibres proceeding from the affected eye should, beyond the chiasma, be pretty equally distributed, so that, though in such a case the two optic nerves will be very dissimilar in size, the optic tracts ought to be of equal bulk; and this is what is most commonly met with. On the other hand, it is undoubtedly the fact that in some of such cases the optic tract on the opposite side is found to be notably atrophied, while that on the same side as the atrophied optic nerve presents a healthy appearance—signs which betoken a pretty complete decussation of the optic fibres at the chiasma.

Different forms of Hemianopia and their causes.—In the cases where the common arrangement obtains—that is, the semi-decussation—it seems to be the inner fibres that cross one another, whilst the outer fibres of each nerve are continued on into the outer part of the corresponding optic tract. The result of this arrangement would be that the fibres from the right half of each retina would proceed to the right optic tract, while those from the left side of each retina would go to the left optic tract; so that if the image of any object should fall simultaneously either on the right side of the two retinæ, or on the left side of the two retinæ, the impressions in either case will be transmitted along one and the same tractus opticus—the right or the left, as the case may be. Therefore it seems clear that, in all cases in which the semi-decussation of the optic fibres obtains, any intracranial lesion which either destroys, seriously presses upon, or disturbs the nutrition of the optic tract on one side, will give rise to an opposite *lateral hemianopia.* If the decussation had chanced to be total there would, on the contrary, have been produced a 'crossed amblyopia.' The optic tract is apt to be involved in some part of its course between the chiasma and the geniculate bodies by different kinds of lesions. Thus, we may have tumours originating in parts of the tract itself; or the tract may become involved secondarily, or pressed upon, by some tumour or hæmorrhage occurring in the crus cerebri or in the posterior tubercle (pulvinar) of the thalamus, or by a tumour originating in the inner and under part of the temporal lobe, or from the bone itself in the middle fossa of the skull.

Two other, much rarer, forms of hemianopia require to be mentioned, which are produced by lesions affecting different parts of the chiasma. One of these is double *temporal hemianopia*, which may be produced by a lesion pressing upon the anterior median portion of the chiasma. Any lesion capable of doing this would probably be a tumour, and it would produce the same effects whether there is a total or a semi-decussation in the chiasma. The lesion would involve the decussating fibres that come from the inner half of the retina on the two sides, and thus would lead to double temporal hemianopia. The other form is known as *nasal hemianopia*, and where semi-decussation of the optic fibres exists it would be produced by a tumour or an aneurysm causing an injurious amount of pressure upon either outer angle of the chiasma, since there would then be paralysis of the fibres emanating from the outer part of the retina, and consequently the suppression of the inner part of the visual field of the corresponding eye. It is only with extreme rarity that this form of hemianopia is double.

We have now to turn to another side of the question. It is natural to ask whether the lateral hemianopia that develops as a consequence of disease of the optic tract will also result *from a lesion which involves the optic fibres beyond the corpora geniculata*—that is, in their deep intracerebral course. This was the view put forward by von Graefe in 1860, and which was very commonly accepted till it was challenged by Charcot some few years since. Relying apparently upon the paucity of cases on record in which lateral hemianopia had resulted from lesions of the cerebral hemispheres themselves, and upon the many cases that had come under his own observation in which 'crossed amblyopia' had been produced by functional or structural lesions involving the posterior or sensory segment of the internal capsule, he came to the theoretical conclusion that all the optic nerve-fibres from each eye went to the opposite cerebral hemisphere, owing to the supposed fact that those fibres which had not decussated at the chiasma did decussate somewhere in the corpora quadrigemina. These views he embodied in a well-known diagram. The subsequent progress of knowledge has, however, not been compatible with this theory. Thus Munk's original statement has been confirmed by Schäfer and S. Brown, to the effect that removal of one occipital lobe in the monkey produces, not crossed amblyopia, but opposite lateral hemianopia (*Brain*, Jan. 1888, p. 367). Again, Seguin, in a valuable memoir (*Journ. of Nerv. and Ment. Dis.*, vol. xiii. Jan. 1886), has shown that opposite lateral hemianopia is more especially produced by lesions in that inner portion of the occipital lobe known as the 'cuneus,' a region supplied by a rather large branch of the posterior cerebral artery which passes along the calcarine fissure. Still it would appear that lesions anywhere in the posterior parietal, temporal, or occipital region of the hemisphere, when they implicate the 'optic radiations' of Gratiolet (*i.e.* fibres passing backwards from the corpora quadrigemina and geniculata to the occipital cortex), are also capable of producing an opposite hemianopia in man of a permanent character. In the lower animals (monkey, dog, &c.), for the production of a similar defect the removal of the occipital lobe must be complete, and even then the defect is of a comparatively brief duration—two or three weeks at most.

There is at present an apparent contradiction between these well-attested facts, as to the production of lateral hemianopia from disease of the occipital lobe (implying as they do that the semi-decussation persists even to the cortical termini of the optic fibres), and the fact of the existence of a 'crossed amblyopia' in association with functional or structural disease of the hinder portion of the internal capsule. A solution of this difficulty cannot as yet be readily found. Ferrier still maintains that crossed amblyopia is produced by destruction of one angular gyrus. He asserts, indeed, that 'the angular gyri are more particularly the centres for clear vision, each mainly for the eye of the opposite side' (*Brit. Med. Journ.*, June 21, 1890, p. 1415).

Diagnosis.—Under this head reference has to be made to different sides of the problem. The first point to be considered is the mode of recognition of the different varieties of hemianopia. In some cases, where the defect is well marked, and the patient is intelligent, he will himself call the observer's attention to it; very frequently, however, such defects are only discovered by being specially looked for. This subject will be referred to under Vision, Defects of. Here it must suffice to say that for all accurate observation an instrument named a 'perimeter' is required, by the aid of which the exact nature and extent of the limitation of the visual field can be discovered; but, for a first rough examination, the following simple method will suffice for the detection of any great narrowing of the visual field in particular directions. The patient stands with his back to the light, and, covering one eye, looks steadily from a distance of eighteen inches at the nose or eye of the observer, who then moves his forefinger about in different parts of the field of vision, and notes any part where the patient says it is invisible or badly seen. Anything like a hemianopic defect, of either variety, may be easily appreciated in this manner.

The fact of the existence of hemianopia having thus been established, we must next seek to determine the site of the lesion by which it has been caused. The problems of regional and of pathological diagnosis are in these cases often intimately related to one another. With respect to the latter problem some hints have already been given.

For purposes of regional diagnosis the first thing is to determine whether the case before us belongs to one or the other of two main categories into which cases of hemianopia are divisible—that is, whether it is a case of *tract* or of *central hemianopia*; and this may be determined by a delicate test first used by Wernicke. This test is based upon the fact that, in the case of lesions in the primary optic centres of one side (the corpus geniculatum and one anterior quadrigeminal body), or of their afferent fibres, there is an interference not only with visual impressions, but also with the path for impressions that excite pupillary contractions through these oculo-motor centres; whereas in the case of deeper lesions, situated in parts of the cerebral hemisphere involving either the optic radiations or the occipital cortex, the pupillary reflex would not be at all interfered with. Thus in cases of 'tract hemianopia' there exists what has been termed hemiopic pupillary inaction; while in cases of 'central hemianopia' this sign does not exist. The sign itself is searched for by throwing a pencil of light obliquely (at an angle of 40°–60°), by means of an ophthalmoscope mirror, on to the blind side of the retinæ, so as to see whether contraction of the pupil is, or is not, produced. If carefully performed, no reaction of the pupil occurs in cases of *tract* hemianopia—that is, where the defect is due either to disease of the afferent fibres, or of the primary optic centre itself. But where the hemianopia is caused by disease in the cerebral hemisphere itself (*central* variety) the contraction of the pupil occurs equally well whether the light be thrown upon the blind or upon the unaffected half of the retina.

From the point of view of a regional diagnosis, we may enumerate four fairly marked types of *central hemianopia.*

1. There are cases in which hemianopia exists alone, or as the most prominent symptom, or in association with certain general signs indicative of the existence of tumor cerebri. Such are the cases where the occipital lobe is affected in or about the region of the cuneus.

2. Cases in which hemianopia coexists with hemianæsthesia and choreiform or ataxic movements of one half of the body, without marked hemiplegia. These are probably due to a lesion of the caudo-lateral part of the thalamus, or of the caudal division of the internal capsule, on the side of the brain opposite to the dark half-fields and the hemianæsthesia.

3. Cases of hemianopia with complete hemiplegia and hemianæsthesia are probably caused by an extensive lesion of the internal capsule in its knee and caudal part.

4. Cases of hemianopia with aphasia and hemiplegia, with or without hemianæsthesia, are probably due to an extensive superficial lesion of the area supplied by the left middle cerebral artery, such as may be brought about by its plugging either from thrombosis or embolism.

In all these cases the pupillary reaction would not be interfered with, and there would be no atrophy of the optic nerves unless as a sequence of choked disc. In addition to these forms, five types of *tract hemianopia* may be enumerated.

1. The first type of tract hemianopia would be caused by lesions in the primary optic centres on one side (the corpus geniculatum and one anterior quadrigeminal body). Little or nothing is known of lesions thus limited, which are excessively rare. Still, such parts may be involved, primarily or secondarily, by a tumour; when amongst a varying group of symptoms we might have, as results of the lesion in the parts specified, lateral hemianopia, hemiopic pupillary inaction, together with early atrophy of the optic nerves.

2. In other cases where disease involves the optic tract and the crus cerebri, we may have hemianopia coexisting with some form of cross-paralysis. A probable combination would be paralysis of the third, fourth, and sixth cranial nerves on the side of the lesion (some one or all of these nerves), together with partial hemiplegia (without anæsthesia), and hemianopia on the opposite side. In some cases choked discs would appear early, without interfering with the hemiopic symptoms until optic atrophy with complete blindness had become established.

3. In cases where the optic tract is involved more anteriorly, other symptoms coexisting with the hemianopia may be very vague and uncertain; but the hemiopic pupillary inaction should be marked, and there should be early partial atrophy of the optic nerves. These latter signs suffice to distinguish this group of cases from those belonging to the first category of 'central hemianopia,' with which otherwise they might be confounded.

4. Cases of bitemporal hemianopia due to lesions pressing upon the anterior part of the chiasma.

5. Cases of nasal hemianopia, mostly single, due to a lesion involving the outer part of the chiasma.

The only other forms of monocular hemianopia are also very rare, and are due to lesions of the optic nerve itself in front of the chiasma.

Other very rare forms of hemianopia affect the superior or inferior, rather than the lateral, segments of the field of vision. As Seguin points out, when these forms exist with a very irregular demarcation line, they are probably still more peripheral in their origin and due to embolism or thrombosis of the central artery of the retina.

In another class of cases, instead of a definite hemiopic defect of sight, we meet with partial, quadrant, or sector-like defects in the upper or lower halves of the visual fields. Little or nothing is known as to the causation of such defects. They might conceivably be caused by disease in certain limited portions of the occipital cortex, or of some only of the fibres constituting the optic radiations. Again, they might be due to a localised damage to some of the fibres of one crus or one optic nerve; or to degeneration of the retina caused by the plugging of some one branch of its central artery.

PROGNOSIS AND TREATMENT. — Nothing special can be said under these heads concerning the hemianopia itself. Both the prognosis and the treatment of this defect are absolutely dependent upon the causative conditions, and the nature and severity of the collateral symptoms with which it is associated. We must, in fact, always seek to mitigate or remove the underlying causal conditions, and upon our chance of being able to do this the prognosis in any given case entirely depends.

H. CHARLTON BASTIAN.

HEMICRANIA (ἡμι-, half; and κρανίον, the head).—Pain limited to one side of the head. The term is, however, generally used as synonymous with megrim. *See* MEGRIM.

HEMIOPIA
HEMIOPSIA } (ἡμι-, half; and ὤψ, sight).—A loss of perceptive power in one lateral or vertical half of the retina. *See* HEMIANOPIA; and VISION, Disorders of.

HEMIPLEGIA (ἡμι-, half; and πλήσσω, I strike).—Paralysis of motion of one side of the body; sometimes applied to loss both of motion and of sensation. *See* PARALYSIS.

HEPATALGIA (ἧπαρ, the liver; and ἄλγος, pain).—Strictly this word signifies pain in connexion with the liver. It has, however, been specially applied to a supposed neuralgic pain referred to this organ, coming on in paroxysms, and said to be of a severe character in some instances, so as to simulate hepatic colic. Whether there is any such affection is exceedingly doubtful; and probably in cases of supposed hepatalgia the neuralgia is either superficial, or there is some tangible but undiscovered cause for the pain, connected with the hepatic apparatus or some neighbouring structure.

FREDERICK T. ROBERTS.

HEPATISATION (ἧπαρ, the liver).—A term applied to the condition produced by acute inflammation of the lung, in which the pulmonary substance becomes solid and friable, resembling somewhat the liver in its physical characters. *See* LUNGS, Inflammation of.

HEPATITIS (ἧπαρ, the liver).—Inflammation of the liver. *See* LIVER, Inflammation of.

HEPATOCELE (ἧπαρ, the liver; and κήλη, a tumour).—Hernia of the liver. *See* LIVER, Displacements of.

HERCULESBAD (HERCULES-FURDO), in Hungary.—Thermal sulphur and muriated saline waters. *See* MINERAL WATERS.

HEREDITY.—By heredity is meant that special property through which the characters and qualities of organisms are transmitted to their descendants throughout successive generations, so that the offspring in their main features resemble their parents. The transmission of parental characters to offspring is a subject for scientific inquiry. It has long been known that a young organism is derived from an ovum formed within the body of the female parent, so that a descent from the mother and a direct continuity through the egg with her structure was apparent. But it is within a comparatively recent period that the direct participation of the male parent in the production of the offspring has been traced. The older writers thought that the semen evolved a vapour or spirit, which influenced the ovum, or that the fluid part of the semen penetrated the vitelline membrane, and induced germinative changes, which resulted in the production of a young organism, without the male contributing any definite structure in the process. The discovery, in 1842, by Dr. Martin Barry, of the penetration of the vitelline membrane by the spermatozoon put the subject on a more definite basis, and the researches of Bütschli, Auerbach, Fol, Strasburger, Flemming, Hertwig, E. van Beneden, and others, have given greater precision and completeness to our conceptions of the process of impregnation. It has now been demonstrated that the young organism arises within the egg by the incorporation, or conjugation, of an extremely minute particle derived from the male parent with an almost equally minute particle derived from the female parent. The particle derived from the male is the head of the spermatozoon, which, after it has penetrated within the ovum, is called the male pronucleus. The particle derived from the female is a portion of the germinal vesicle, which has remained included within the egg, and is called the female pronucleus. The male and female pronuclei gradually approximate, touch, and then become incorporated with each other, and form what is called the segmentation-nucleus. The segmentation-nucleus consists of chromatin fibres and nucleoplasm, which are derived both from the nucleus of a male sperm cell, *i.e.* the head of a spermatozoon, and from the nucleus of a female germ cell, *i.e.* the germinal vesicle. The segmentation-nucleus is therefore a composite or hermaphrodite nucleus, and consists of matter derived from both parents. This composite nucleus then rapidly divides and subdivides within the ovum, so as to produce daughter-nuclei, and the protoplasm of the yelk undergoes a corresponding process of division. Each of the daughter-nuclei becomes surrounded by a layer of protoplasm, and numerous new cells are produced. The nucleus of each of these new cells contains chromatin fibres derived from the segmentation-nucleus, and through it from the corresponding fibres of the nucleus of the male sperm cell and of the female germ cell. It is believed that the male and female chromatin fibres enter in equal proportions into the structure of the nuclei derived by division from the segmentation-nucleus, so that each of the nuclei of the new cells, like the segmentation-nucleus, is composite or hermaphrodite, *i.e.* represents both parents. The cells produced by the division of the segmentation-nucleus and its envelope of yelk-protoplasm form the blastodermic membrane. In man and the higher organisms this membrane consists of three layers of cells, named epiblast, mesoblast, and hypoblast. From these layers, by a continuous process of division and subdivision of the nuclei of their constituent cells, accompanied by a differentiation of the protoplasm, all the tissues and organs of the body are descended. As the nuclei of all the cells in the body are derived by continuous descent from the nucleated cells of the blastoderm, and as these again are the descendants of the segmentation-nucleus, one may infer that the nucleus of each cell is composite or hermaphrodite and represents both parents.

The changes which take place in a nucleus during its division constitute the process of *karyokinesis* or *karyomitosis.* They consist at first in an enlargement and rearrangement of the chromatin fibres of the nucleus, and then in a splitting of each fibre into two daughter-threads, so that each daughter-thread divides itself equally between the two daughter-nuclei which are formed by the splitting of the parent nucleus. As this process goes on throughout the whole period of cell-multiplication, there is an actual transmission of structure from the segmentation-nucleus to the nuclei of all the cells derived both directly and indirectly from it. Now, as this descent in structure is in all probability associated with a power of transmitting properties, and as the segmentation-nucleus consists of material derived from both parents, a structural medium is provided for the transmission of the characters of the parents to their offspring, and the phenomena of heredity may be said to rest on a physical basis.

The material which forms the structure of the male and female pronuclei and the segmentation-nucleus has been termed by Weismann the *germ-plasm.* He believes that in each individual produced by sexual generation, a portion of the germ-plasm derived from both parents is not employed in the construction of the nuclei of the cells and tissues of the soma or personal structure of the individual, but is set aside unchanged for the formation of the germ cells of the succeeding generation. According to this theory there is a direct continuity of germ-plasm from one generation to another, which acts as the conveyer of hereditary characters. Weismann maintains that the germ-plasm is not modified by the habits and mode of life of the individual, and he conceives it to be transmitted from one generation to another uninfluenced by the conditions of life in which the individual is placed. He assumes that the reproductive cells which contain the germ-plasm are not acted on by the organs and tissues of the body in which they are situated, except in so far as they may be affected by general conditions of growth and nutrition. Hence, he concludes that characters acquired by individuals during their lifetime from any external cause, which modify the persona or soma, cannot be transmitted to their offspring.

Several arguments may, however, be advanced in opposition to Weismann's conclusion, which seems to require for its confirmation that the germ-plasm of the reproductive cells should, from the commencement of the development of the embryo, be isolated from the cells from which the other organs of the body are derived. But both reproductive cells and soma cells are formed in the fertilised ovum by the segmentation of the nucleus, and the reproductive cells in man and other vertebrates do not appear as isolated organs until after the rudiments of all the great organic systems have been mapped out. Hence, before they are set aside as germ cells or sperm cells, the germ-plasm has apparently been in a stage of diffusion, and under precisely the same influences as those which in the embryo affect the formative cells of the body generally, so that the conditions which would secure the germ-plasm and the soma cells from mutual interaction are not complied with.

Further, there is experimental evidence to show that in placental mammals an interchange of material takes place during gestation in opposite directions from fœtus to mother, as well as from mother to fœtus. A character derived by a fœtus by descent from its male parent may thus be acquired by the mother from the fœtus, and influence the germ-plasm of her reproductive cells so as to be transmitted to her future offspring, even though they may not have the same male parent. Hence, it is an axiom with those engaged in the breeding of particular kinds of stock, that, if they wish to keep the strain pure, the mother must not at any time be allowed to beget offspring by sires of another blood.

The hereditary transmission of characters from parents to offspring is not limited to such as are normal and physiological, and of service in the perpetuation of the species and of the race. Characters which are of no service, and, indeed, are detrimental to the individuals in whom they occur, may also be transmitted, and it is from this point of view that the subject of HEREDITY requires to be considered in this place. The study of those modifications in the structure of the body, which pathologists group together under the name of Congenital Malformations, has furnished numerous illustrations of the descent in families of variations from the normal structure. Familiar examples are furnished in the presence of supernumerary digits on the hands or feet in some families, or a diminution in their number in others. But modifications or variations in structure that can be transmitted from parents to offspring are by no means limited to changes which can be recognised by the naked eye. They are sometimes so minute as to be determined rather by the modifications which they occasion in the functions of an organ than by the ready recognition of structural variations. One might adduce as an example Daltonism, or colour-blindness, which has distinctly been shown to be hereditary, and which is due apparently to a minute structural defect in the development of the retina, or the optic nerve, or the brain itself, occurring in particular families.

But there are certain diseases which occur in some families more than in others, and which are regarded as hereditary. Some of these are discussed in the article PREDISPOSITION TO DISEASE, but in addition to the examples there given, it may be stated that in some families there is a strong tendency to the production of cataract in successive generations, and in other families an equally strong predisposition to the hæmorrhagic diathesis. When we speak of tendencies, susceptibilities, proclivities, or predisposition to the transmission of characters, whether they be those of health or of disease, we employ terms which undoubtedly have a certain vagueness. We are quite unable to recognise, even with the highest powers of the microscope, any structural difference in the germ-plasm in different persons which would enable us to say that in one family a particular feature should have one form, in another family a different form; or that in one family there should be a tendency or susceptibility to one kind of disease, whilst another family should display a special capacity for transmitting another form of disease. We can only determine that such a sequence will take place by tracing the life-history of the individuals belonging to these families. Though, as we have said, these terms have a certain vagueness, and are wanting in scientific precision, yet it is not the less true that they express a something of the importance of which we are all conscious, though we may not be able to formulate it in a precise definition.

WILLIAM TURNER.

HERMAPHRODITE (Ἑρμῆς, Mercury; and Ἀφροδίτη, Venus).—A term applied to an individual in whom the formation of the sexual organs is such as to give rise to the impression that both the male and the female organs are present. *See* MALFORMATIONS.

HERNIA (*hernia*, a rupture).—SYNON.: Fr. *Hernie*; Ger. *Bruch.*

DEFINITION.—This word is used in surgery to express the protrusion of any viscus from the cavity in which it is naturally placed. In this article, however, the observations are exclusively restricted to protrusions of the viscera of the abdomen through the walls of that cavity, and it is only intended to give a mere outline of the subject, its full discussion being beyond the scope of this work, as it is mainly connected with surgery.

GENERAL REMARKS. — Hernial displacements take place in both sexes and at all ages. The most striking objective sign of the existence of a hernia is a fulness or swelling in one or other of those regions of the abdomen where, from the anatomical construction of its walls, the tissues are weakest. When the parietes are defective, in consequence of local disease or injury, visceral protrusions may occur at those spots; and also as the result of congenital malformation in both sexes, a fruitful cause of hernia being the non-closure of the vaginal process of the peritoneum at birth, or a patulous state of the umbilical aperture. Such a protruded viscus forms a hernial swelling or tumour. The tumour is composed of a sac, its contents, and the tissues outside the sac. The sac is composed of a prolongation of the peritoneum in most cases; and its orifice, neck, or abdominal aperture, constitutes, with the tissues around it, a frequent cause of impediment to replacement or 'reduction' of the hernia. The hernia may be a part of any abdominal viscus, but those most mobile are usually displaced. Thus, in the majority of cases, either the omentum or small intestines, together or singly, form the hernia. The tissues outside the sac are those which exist in the region where the tumour is formed, and they are frequently described as the coverings of the sac.

Every hernial tumour possesses a neck, body, and fundus.

The first or earliest objective symptom of a hernial protrusion is an unusual fulness, as, for example, in the groin in a case of inguinal hernia. This swelling is transient, appearing and disappearing in relation to the actions or posture of the individual. When pressed with the finger the swelling disappears; but it is readily reproduced if the patient contracts the abdominal muscles, and then with the finger an impulse is felt, produced by the protruding viscus. By slow degrees the bulk of the swelling increases, until, if no support or 'truss' be used, very large tumours are formed.

CLASSIFICATION.—The most practical classification of hernial protrusions is based upon the usual triple division of the abdomen into regions—namely, the epigastrium, mesogastrium, and hypogastrium.

1. Protrusions in the epigastric region are very rare. They are (*a*) *diaphragmatic*; and (*b*) *epigastric.*

Diaphragmatic hernia is due either to relaxation of the tissue of the diaphragm muscle, or to its laceration. In some cases congenital deficiency of the muscle is the primary cause; in others the natural openings in the muscle become dilated. Signs of this hernia are very obscure; but when the protrusion depends upon laceration of the muscle, the occurrence of a recent injury may excite suspicion, if associated with abnormal sounds in the thorax.

Epigastric hernia escapes at the region formed by the cartilages of the false ribs on either side of the linea alba. It is very rare, and, as the abdominal orifice of the sac is usually large, the hernia is easily reduced.

2. The hernias in the mesogastrium are (*a*) *ventral*; (*b*) *umbilical*; and (*c*) *lumbar.*

The term *ventral* is given to any hernial protrusions escaping through abnormal openings in the walls of the abdomen to which no special name is given. They are seen in the region of the linea alba, above the umbilicus, but most frequently below it; in the line of the linea semilunaris; and even opposite the muscular walls. Commonly of traumatic origin, their nature is clearly shown by the ready manner in which the protruded viscus can be pressed back into the abdomen. They sometimes ensue upon the weakening of the walls after distension, or upon the loss of tissue following abscess.

Umbilical hernia is met with at all ages and in both sexes. It forms a tumour at the site of the umbilicus in the first instance, and gradually descends over the linea alba as its bulk increases. Very soon after birth this variety of hernia appears. The protrusion takes place at the umbilical ring, and, pushing before it the peritoneum, an acquired hernial sac is formed. To prevent, therefore, the development of the sac in infancy, and to assist the closure of the ring in the linea alba, a slightly convex disc of cork, enclosed in washleather, should be strapped over the umbilical aperture. The prognosis of infantile umbilical hernia is favourable, for the aperture closes with age, and the tissues continue firm.

In adult life this kind of hernia is frequent in fat individuals. The tumour often acquires enormous proportions. Its contents consist of small intestine and omentum, with not uncommonly a portion of the transverse colon. Accumulations of fæcal matter therein often give rise to obstruction, and the symptoms arising in consequence of this state more or less resemble those of strangulated small intestine. A correct diagnosis of their cause may usually, however, be arrived at from the history of the attack, the comparative mildness of the malady, and the alleviation of the symptoms by exciting the action of the bowels. The contents of this form of hernia, when of long standing, often become adherent or bound by bands to the sac, in which state they remain permanently irreducible.

When the protruded viscus can be entirely reduced within the abdominal cavity, a suitable well-fitting truss should be worn constantly; if irreducible, one adapted to the circumstances of the case must be used.

Lumbar hernia takes place in the loins. It is a very rare variety, and usually occurs as the result of an injury.

3. The herniæ in the hypogastrium are the most numerous and the most common. They include (*a*) *inguino-scrotal* or *inguino-labial, above* Poupart's ligament; (*b*) *femoral, below* Poupart's ligament; (*c*) protrusions through the apertures of the pelvis in front, beneath the horizontal ramus of the pubes—*obturator*; (*d*) beneath the arch of the pubes—*perineal*, *pudendal*, *vaginal*; and (*e*) behind, through the ischiatic notch—*ischiatic*.

(*a*) *Inguinal* hernia is seen at all ages and in both sexes. The following varieties are described: the *oblique* or *external*; and the *direct* or *internal*. In the first, the orifice of the sac is outside the course of the internal epigastric artery; in the second it is internal to the same vessel. When the protrusion forming an inguinal hernia does not descend below the inguinal canal it is termed a *bubonocele*; but when it occupies the scrotum or labium it forms an *inguino-scrotal* or *inguino-labial* tumour. The essential difference between the inguinal hernia of youth and of middle age is due to the constitution of the sac which encloses the protrusion. From infancy to early adult life, protruding viscera escape from the abdomen into a serous sheath continuous with the parietal peritoneum, namely, the vaginal process of that membrane which extends into the scrotum or labium. In middle life and afterwards, the parietal peritoneum is thrust through the apertures or weak points in the abdominal walls by the protruding viscus. In this way two distinct kinds of hernial sac are formed: the first being due to a congenital defect; the second, to a mechanical and acquired cause. In practice, it is very important to bear these distinctions in mind. In the first kind a truss is applied to prevent the passage of the viscus into the sheath, in the hope that by this means its walls may unite and its orifice contract—in fact, to assist nature in accomplishing that condition, the failure of which permits the protrusion to take place. But, in the second, a truss is used to prevent the protruding viscus pushing the peritoneum before it, and so forming for itself a sac. Thus, if the development of the sac be arrested, there can be no hernial tumour.

Inguinal herniæ occupy the inguinal canal, and are therefore in relation with the spermatic cord of the male and the round ligament of the female. They escape from the canal through the external abdominal ring into the scrotum or labium. The neck of the tumour is always therefore above Poupart's ligament, and to the inner side of the external pillar of the external abdominal ring. This anatomical fact constitutes the main distinction between inguinal and femoral hernia.

(*b*) *Femoral* hernia forms a tumour at the inner and upper part of the thigh, immediately below the pubic attachments of Poupart's ligament. These structures are in immediate relation with the neck of the sac. The protrusion escapes at the femoral aperture, the site of the entrance of the lymphatic vessels of the thigh to the abdominal cavity. The neck of the sac is therefore to the inner side of the sheath of the femoral vessels; although, in proportion to the bulk of the tumour, its body may overlie it, and even extend upwards above Poupart's ligament, and outwards towards the crest of the ilium. The sac of a femoral hernia is always an acquired formation. Hence the importance of wearing a truss after observing the slightest indication of a femoral protrusion. For if the yielding, relaxed, parietal peritoneum be supported at the crural aperture by a well-adjusted pad, a visceral hernia must be avoided, as there will be no sac into which it can escape. In other words, arrest the development of the sac and there can be no hernia.

To discriminate between a femoral and an inguinal hernia, place the index finger upon the spinous process of the pubes; if the neck of the tumour is to its outer side, and the whole length of Poupart's ligament can be traced above it, a femoral hernia exists. Should precisely the reverse conditions be ascertained, the tumour will depend upon an inguinal protrusion. Another method for diagnosis is the direct and careful examination of the site of the femoral aperture. If it is clearly and distinctly tangible and well-defined, it cannot be occupied by a hernial protrusion.

Femoral hernia is most common in the adult female. It has been developed before ten years of age; is rare between that age and twenty; but is very frequent in persons between twenty and forty years old. Prolific women are more frequently the subjects of this hernia than the single and sterile.

(*c*) *Obturator* hernia escapes from the pelvis through the thyroid foramen, and traverses the canal normally occupied by the obturator nerve and vessels. It is rarely met with. A fulness, rather than a tumour, is produced by the protrusion at the inner or pubic region of the thigh, beneath the pectineus muscle, and accompanied by a peculiar numbness and pain, which may be traced to the distribution of the filaments of the obturator nerve. The lives of patients have been lost in consequence of overlooking these herniæ; the cause of death being only ascertained *post mortem.*

(*d*) *Perineal, pudendal, vaginal,* and (*e*) *ischiatic* hernias are very rarely seen. The name assigned to each indicates the locality in which the tumour is formed; and for a special description of them the reader must be referred to monographs on the subject of this article.

Effects and Treatment.—We must next, as briefly as possible, describe generally the various morbid conditions which the hernia itself may undergo, and the means by which serious consequences from such conditions may be averted.

All hernial protrusions are either reducible or irreducible—that is, they can either be restored to their normal situation, or they may be permanently confined to the region in which they are protruded.

The treatment of all reducible herniæ consists in the employment of means to prevent the escape of the protrusion. To effect this object various kinds of bandages or trusses have been devised. Each kind of hernia requires its special form of truss, and every individual should, as far as practicable, obtain a truss well fitted to his or her configuration. The essentials of a good truss consist in the spring having sufficient power to support the hernia and prevent its escape, while it should not be so strong as to injure the structures about the abdominal rings. The pad should be firm, of a shape suitable to the case, and of a size not inconvenient to the wearer.

The irreducibility of a hernia depends on its bulk, adhesions, and special anatomical conditions. Under such circumstances special bandages must be employed.

But other much more important morbid states of the protruded viscus than the above cause impediments to the reduction of a hernia, namely: (1) *constriction* by the tissues around the orifice of the sac; (2) *accumulation* of fæcal matter in the protruded viscus; (3) *inflammation* of the hernia; and (4) *strangulation*, when a part of the alimentary canal forms the hernia.

(1) Those herniæ—for example, the inguinal—which pass through openings in the muscular walls of the abdomen, are liable to *constriction* from contraction of the muscular tissue. Inguinal herniæ of long standing, and more than ordinary bulk, are very prone to become irreducible in consequence of muscular contraction. Such cases are well adapted to illustrate the effects of anæsthetics, and their influence on muscular irritability. If the patient be placed under the full influence of chloroform, the abdominal muscles become relaxed, and the hernia is quickly reduced.

(2) Hernial protrusions formed of large intestine, such as occur at the umbilicus, frequently become irreducible from fæcal *accumulations.* In these cases enemata, and even purgative medicines cautiously prescribed, frequently relieve the symptoms.

(3) *Inflammation* excited in an omental protrusion may cause temporary and even permanent irreducibility. Local and constitutional symptoms of a rather severe type sometimes attend such cases. The usual methods adopted to induce resolution must be employed.

(4) A morbid state of the protruded bowel termed *strangulation* has next to be described. A patient the subject of this state remains in the greatest danger to life so long as the exciting cause, the constriction of the bowel, exists. Hour by hour that danger increases; and, although rare instances of recovery might be quoted after the continuance of strangulation for many hours, the majority of patients die because the intestine was not liberated early enough. A hernia is described as strangulated when subject to a constriction which at first impedes, and sooner or later arrests, the circulation of the blood in its capillary vessels. The passage of the intestinal contents is necessarily stopped. The local and constitutional symptoms are strikingly characteristic. Very frequently the first symptom is vomiting, unaccompanied by any alvine evacuation. The vomiting continues, and is excited by ingesta. This state is probably due to mere obstruction of the alimentary canal, but it ought always to excite the anxious solicitude of the medical attendant to ascertain whether the patient has any outward signs of a hernial tumour. He must examine those regions at which protrusions commonly occur, and never rest content with the statements of the sufferer. At first the pulse is not affected in a very marked way, but as vomiting continues the heart beats more rapidly, whilst the pulse becomes weaker and contracted. The surface, especially that of the extremities, becomes cold; the countenance aged and anxious; the visage, lips, and hands shrivelled and bluish; the prostration extreme. The tumour is painful when touched, and it may have increased in size and become tense. All these facts indicate progressive morbid changes in the tissues of the strangulated bowel, as well as in that part of the alimentary canal above the hernia. Besides the mere act of vomiting all ingesta, the characters of the fluid vomited must be carefully noted. Usually, at first, it is the food last swallowed, more or less digested and mingled with bile; in the second stage it becomes yellowish and greenish; and at last it is stercoraceous—that is,

offensive to smell, of a brownish colour and frothy, and often in great quantity. Now the only treatment of these urgent symptoms consists in the liberation of the bowel by surgical means. In the meantime palliatives may be employed, opium administered by the mouth, enemata injected, local applications of ice used, and gentle taxis applied.

John Birkett.

HERNIA CEREBRI.—*See* Brain, Malformations of; and Skull, Diseases and Deformities of.

HERPES (ἕρπω, to creep).—Synon.: Fr. *Dartre*; Ger. *Herpes, Bläschenflechte.*

The name 'herpes' was formerly applied to a large group of skin affections, which were associated together on account of a supposed similarity in the eruption, although they bore very little real relation to each other. Thus we had herpes iris, herpes circinatus, and herpes gestationis, diseases which are perfectly distinct from any kind of true herpes. At present only three forms of herpes are recognised: *herpes facialis*, *herpes progenitalis*, and *herpes zoster*; all of which resemble each other not only in the character of the eruption, but also in running an acute and definite course, and in having a neurotic origin. As, however, herpes zoster differs considerably from the other two, it is conveniently distinguished by the name *zona*. This nomenclature has the merit of simplicity, and is that of the College of Physicians.

1. **Herpes Facialis.**—Synon.: Herpes febrilis; Herpes labialis.

Herpes facialis consists of a small group, or groups, of vesicles on a red base. The eruption is associated with some swelling of the skin or mucous membrane, and with a sensation of very slight pain and stiffness of the part affected. It is most commonly met with on the lips, but occasionally on the alæ of the nose, the ear, or the cheek. It is also not uncommon on the buccal mucous membrane, and on that of the soft palate and uvula. It is generally, but by no means always, confined to one side, and this is more observable on the face or ear than on the lips, where it often extends to both sides of the middle line. The eruption is frequently associated with catarrh of the air-passages, and, though quite unimportant, is apt to recur. No treatment is required, as the eruption disappears in a few days, but a lotion of carbolic acid may be usefully applied.

2. **Herpes Progenitalis.**—This disease differs but little from herpes facialis except in the part affected; it is, however, very apt to be troublesome, especially when irritated by rubbing or injudicious treatment. The eruption is met with in both sexes, but is more common in the male than in the female. In men it appears on the prepuce or glans penis; in women on the labia or adjacent mucous membrane. When irritated, it is apt to form small ulcers, which are difficult to heal, and which lead to enlargement of the inguinal glands. Under these circumstances herpes has often been mistaken for syphilis.

Treatment.—This should be always of the most soothing kind, such as the application of water dressing or a very weak boric acid or lead lotion, with mild aperients.

3. **Zona.**—Synon.: Herpes zoster; Shingles.

Definition.—An acute inflammatory disease of the skin, running a definite course, consisting of groups of vesicles on an inflamed base, and distributed irregularly along the course of cutaneous nerves. The eruption is usually unilateral, and is apt to produce scars.

Symptoms.—Zona is by far the most important form of herpes. It is met with most commonly on the trunk, where it follows the course of some of the intercostal or lumbar nerves, and often in the gouty diathesis. It is also not very uncommon in the supra-orbital region, and is occasionally met with following the course of some cutaneous nerves down the arm or leg. It is said to be more common on the right than on the left side of the body. The eruption is preceded by a very considerable amount of neuralgic pain and discomfort, which may even last for days before the eruption appears, and has often been mistaken for the pain of pleurisy. The first appearance of the eruption is a bright-red patch or patches, on which are then developed groups of vesicles of rather large size, sometimes even amounting to blebs. The contents of the vesicles become puriform; and they ultimately dry up and leave scabs, which generally fall off without producing permanent scars. Occasionally, however. troublesome ulcers form, leaving behind deep depressed scars. Mild cases of zona are very apt to abort, the eruption hardly developing into true vesicles; this imperfect development may also be seen in the outlying groups of the eruption in well-developed cases. As a rule the eruption of zona runs a definite course of about a fortnight; there are, however, not a few exceptions in which the period of development is prolonged beyond the normal time. The disease is not very apt to recur, and in this respect it differs from herpes labialis and preputialis. When zona occurs in the neighbourhood of lymphatic glands, these almost always become enlarged during the attack.

Prognosis.—There are two points connected with zona that require especial notice. (1) The gravity of the disease, apart from the amount of eruption, is, broadly speaking, in proportion to the age of the patient. In children and young adults, as soon as the sores have healed the patient is generally quite well, and no trace of the disease is left except perhaps a few small scars and a slight tenderness of the skin. In the middle aged, and still more in elderly people, this is not the case: the eruption is almost always followed by some form of nerve disturbance, generally of a severe neuralgic kind, which may last for months; in other cases, attacks of a kind of vertigo follow the zona. In very old people an attack of zona is a serious matter from which they seldom entirely recover. (2) It must be always borne in mind that supra-orbital zona is very apt to leave deep depressed scars. The patient should invariably be warned of this in the first instance, otherwise the formation of the scars may be attributed to neglect or injudicious treatment. Sometimes the eye itself is involved in the eruption; and cases of blindness are not unknown as the result of a severe attack of zona.

Treatment.—The treatment of this eruption is very simple. It should be protected from the pressure of the clothes as far as possible. This may be done with a good pad of cotton wool. Lotions should generally be avoided; and simple powders, such as oxide of zinc or starch, should be well dusted on several times daily. The treatment of the neuralgia which follows zona is most difficult. The pain is often of the most violent darting kind, and not amenable to treatment. All the ordinary remedies used in neuralgia may be tried, including hypodermic injections of morphine and quinine. *See* Neuralgia. Robert Liveing.

HETEROLOGOUS (ἕτερος, other; and λόγος, nature).—A word used to characterise any morbid product, whether fluid or solid, which is different in composition or structure from the normal fluids or solids of the body.

HETEROMORPHOUS (ἕτερος, other; and μορφή, form).—Applied to new-formations which are different in form and structure from the normal tissues.

HETEROTOPOUS (ἕτερος, other; and τόπος, a place).—Misplaced. A term applied to the appearance either of a normal tissue in an unnatural situation—for example, of hairs on mucous surfaces; or of morbid growths in unusual places—for instance, of epithelioma in nervous tissue.

HICCUP or HICCOUGH.—Synon.: *Singultus*; Fr. *Hoquet*; Ger. *der Schlucken*.

Description.—Hiccup, according to physiologists, is a sudden spasmodic descent of the diaphragm accompanied by a spasmodic closure of the glottis, the characteristic noise being caused by the incoming column of air striking against the partially closed glottis. The assumption of a spasmodic closure of the glottis in hiccup seems scarcely warrantable. Normally the descent of the diaphragm in each respiratory act is accompanied by a contraction of the posterior crico-arytænoid muscles, which causes an outward rotation of the arytænoid cartilages, and a dilatation of the glottic aperture. The diaphragmatic and the laryngeal acts keep time together, and in health the rhythm of sixteen or eighteen to the minute is maintained. If, however, the diaphragm give a sudden descending jerk irrespective of any respiratory need, as is the case in hiccup, and this jerk occur at a time when the dilators of the glottis are not acting, a noise will be produced by the rush of air through the insufficiently widened glottic aperture. It seems certainly possible to account for the noise of hiccup by the mere fact of the descent of the diaphragm occurring when the glottis is not properly open. The noise is not a constant phenomenon, and during an attack of hiccup it never occurs during ordinary inspiration, or without the spasmodic action of the diaphragm, although the latter phenomenon may occur without the former.

Ætiology and Diagnosis.—Hiccup may be produced by any irritation of the phrenic nerve—its origin, its course, or the ultimate twigs which are distributed to the under-surface of the diaphragm. Undue distension of the stomach, by being overfilled with food or drink, or by an accumulation of wind due to faulty digestion, is the most common cause of hiccup. Its occurrence from this cause is far more common in children than in adults. Convulsions and muscular spasms generally are more easily caused in the young, and hiccup in this respect follows the ordinary rule. Hiccup is produced by direct or by reflex irritation. With many persons the introduction of hot spiced or peppery foods into the stomach immediately produces hiccup, and the writer knows one or two persons in whom hiccup is produced by the passage of hot fluids through the pharynx. It is a frequent symptom in peritonitis when the peritoneal covering of the diaphragm becomes affected. It sometimes occurs in cases of cancer of the stomach; occasionally, perhaps, from over-distension of the organ, but more often from an extension of the cancerous disease to the peritoneal surface of the stomach. It is occasionally a troublesome symptom during convalescence in cholera, and is often accompanied by eructations of wind, and sometimes by vomiting. If hiccup occur with any persistency in the course of typhoid fever, it is often an indication of perforation and the onset of general peritonitis. Although most frequently a symptom of gastric or abdominal disturbance, hiccup occasionally occurs as a true neurosis. It may accompany hydrocephalus or meningitis, and is then due probably to an implication of the cerebral origin of the phrenic nerve. Cases of obstinate hiccuping in hysterical subjects have been recorded, and cases of paroxysmal hiccup have been observed by Liveing, Prichard, and others, which have been regarded as instances of modified epilepsy.

Treatment.—The treatment of hiccup will depend upon the cause. An emetic to empty the stomach, or a stimulant to increase its natural peristaltic action, will often give relief. If we can manage to produce a forcible action of the diaphragm, we may often succeed in curing it, as it were, of the trick of spasmodic action. Attempts to count a hundred without drawing breath, or to hold the breath for a minute, are familiar remedies for hiccup; and, by producing a feeling of suffocation, and necessitating a violent descent of the diaphragm, they are often successful. Warm applications or counter-irritation applied to the diaphragmatic region or over the cervical spine, may occasionally give relief. Pressure upon the trunk of the phrenic nerve by means of the finger applied over the scalenus anticus muscle, is said also to have given relief occasionally in obstinate cases. Amongst the drugs which have been recommended for the relief of hiccup are chloroform (administered internally), either alone or combined with opium; camphor in the form of a spirit solution, in doses of twenty drops and upwards; valerianate of zinc, belladonna, bromide of potassium, musk, or antacids; and, in very severe cases, morphine administered hypodermically.

G. V. Poore.

HIPPURIA (ἵππος, a horse; and οὖρον, urine).—The condition of the urine in which it contains hippuric acid in excess. *See* Urine, Morbid Conditions of.

HISTRIONIC SPASM (*histrio*, an actor).—A synonym for facial spasm, so called on account of the contortions of the face to which this affection gives rise. *See* Facial Spasm.

HIVES.—A popular term for chicken-pox. *See* Chicken-pox.

HOARSENESS (Sax., *has*, having a rough voice).—Roughness of the voice, due to disease or disorder connected with the larynx. *See* Voice, Disorders of.

HOBNAIL LIVER.—A name given to a cirrhotic liver, when it presents small prominences on its surface, somewhat resembling hobnails. *See* Liver, Cirrhosis of.

HODGKIN'S DISEASE.—A synonym for lymphadenoma or lymphoma. *See* Lymphadenoma.

HOMBURG, in Germany.—Common salt waters. *See* Mineral Waters.

HOMICIDAL INSANITY.—*See* Crime, Irresponsibility for; and Insanity, Impulsive.

HOMOLOGOUS (ὁμός, like; and λόγος, nature).—In pathology this term is applied to new-growths presenting the same structure as normal tissues, such as fatty or fibrous tumours.

HOOPING-COUGH.—*See* Whooping-cough.

HORDEOLUM (*hordeum*, a barley-corn).—A synonym for stye. *See* Stye.

HORN-POX.—A popular term for a variety of chicken-pox. *See* Chicken-pox.

HORNS.—Synon.: *Cornua.*—Definition.—Horns are epidermic and epithelial formations, consequent on hypertrophy of the horny product of the integument.

Description.—Horns generally occur singly. Sometimes they attain a size of several inches in length and in circumference. They have been met with on all parts of the body, more particularly on the scalp, the face, the glans penis, and the glans clitoridis.

Pathology.—When the inspissated product of the follicles of the skin, consisting of laminated epithelium and sebaceous matter, is exposed to the air, it dries, becomes hard and transparent, and is in fact converted into a mass having most of the properties of horn. This is the principal source of the horns of the integument—an accumulation of the contents of a follicle; the protrusion of that substance through the dilated aperture of the follicle, sometimes through a large opening resulting from atrophy or ulceration; its desiccation by the atmosphere; and its growth by continued additions to its base. Being essentially the protrusion of a soft substance through a constricted aperture, the surface of the horn will be modelled in figure by the shape of that aperture; in consequence of desiccation, its shaft will be smaller than its base; and it will be liable to be bent or twisted in the operation of protrusion. Hence these horns are generally curved or twisted, and have been compared to the beak of a bird, or the horn of the goat. A section of the horn affords similar evidence of its manner of formation and growth, it being always laminated in structure.

Another kind of horn is sometimes met with on the glans penis and clitoridis, and is the product of hypertrophy of the papillæ. This form of growth is fibrous in structure, like a wart, which in fact it closely resembles; whilst in the same situation concreted masses are occasionally formed, constituted by a combination of both processes—namely, papillary hypertrophy and accumulation of follicular substance. There is, however, an important difference between the two kinds of horn, the sebaceous and the epidermic—namely, that the former is the mere result of increased activity of function, whilst the latter is the consequence of hyperæmia or inflammation.

Treatment.—Horny matter being susceptible of disintegration by moisture, the sebaceous horn may be so thoroughly softened by envelopment in a waterproof covering, or by a poultice, as to be easily broken away at its base. The follicular bed from which it has been removed may then be cleared by a small scoop, when the sac will contract and close. Sometimes it may be thought desirable to sponge the surface with a solution of chloride of zinc or sulphate of copper; but operation by the knife seems quite uncalled for. In the instances of epidermic and epithelial horn, however, it will be necessary to have recourse to caustics, especially potassa fusa; and when the case evinces great obstinacy, or where an epitheliomatous degeneration is suspected, the use of the knife becomes essential.

Erasmus Wilson.

HORRIPILATION (*horreo*, I bristle up; and *pilus*, a hair).—A sensation of chilliness and creeping, the hairs of the general surface of the skin appearing to stand on end. *See* Rigor.

HOSPITALISM.—The term 'Hospitalism' was introduced into medical literature by Sir James Simpson (*Edinburgh Medical Journal*, March 1869), but, as far as the writer can see, no exact definition of it was given by its author. It, however, was evidently intended to signify 'the hygienic evils which the system of huge and colossal hospital edifices has hitherto been made to involve'—to use Sir James Simpson's own words. These evils appeared to him so evident, and so necessarily connected with the size of the hospital, that he taught (and in fact the sole object of his papers was to teach) that our system ought to be revolutionised—'hospitals changed from being crowded palaces, with a layer of sick on each flat, into villages or cottages, with one, or at most two, patients in each room—the village constructed of iron instead of brick or stone, and taken down and rebuilt every few years.'

Mr. Erichsen has, to some extent, accepted the teaching of Sir James Simpson, though he allows that some of it is very questionable. His tract on the subject of Hospitalism has the advantage of being written in a more sober style than Sir James Simpson's, and also of putting the question in a clearer light.

By the term, he says, 'is meant a general morbid condition of the building, or of its atmosphere, productive of disease. . . . Doubtless,' says Mr. Erichsen, 'all the septic diseases that are met with in hospitals may be encountered in the practice of surgeons out of these institutions, but they are unquestionably infinitely more common in hospital than in private practice, and their causes are certainly different.'[1] The writer believes, on the contrary, that, if a hospital be properly managed, there is no general morbid condition of the building—that there is no reason for thinking that septic diseases are more common relatively in hospitals than out of them—and that their causes are identical wherever they occur.

And if the term 'Hospitalism' is to be taken in the sense in which Sir James Simpson evidently intended—that is, as meaning to convey the idea that there is an inevitable tendency to the generation of septic disease in large hospitals, that that tendency becomes greater as the size of the hospital is increased, and that it increases as the hospital grows older—the writer has no hesitation in saying that there is no such thing as Hospitalism. No doubt the aggregation of the sick and wounded in hospitals is a cause of danger, and much care and vigilance are required to keep hospitals healthy. But the dangers are in no sense peculiar to hospitals. The surgical affections which spring up in hospitals—erysipelas, phagedæna, pyæmia, and allied affections—all of them prevail in private practice, and, as far as has been shown, prevail equally.[2] Further, although the perfect publicity of our hospital practice enables us to obtain tolerably accurate data for a comparison of the experience of the smaller and larger hospitals of this and other towns, no one has ever seen the least reason for believing that the smaller are in any respect healthier than the larger; while several of the hospitals that have been longest built are renowned for their healthy condition, and in many large hospitals, parts of which are ancient and other parts modern, the former, if equally well or better constructed, are (under similar conditions of cases and management) as healthy or more healthy than the parts more recently built.

The subject is not one which can be passed over as dealing with an insignificant question, or one of verbal interest only. The doctrines which Sir James Simpson taught led him to deprecate altogether the construction of any hospital of considerable size, and to advocate the extravagant proposal above quoted for substituting small detached temporary sheds for our present permanent hospitals. The same views led Mr. Erichsen to say that when a hospital had become, as he phrased it, 'pyæmia-stricken,' it ought to be destroyed,[1] while similar ideas have led others, such as the late Dr. Farr and Miss Nightingale, to question whether hospitals had not destroyed more lives than they had saved. Such doctrines should not be passed over in silence, since they exercise a great influence on the public, on whose co-operation the efficiency of our hospital system is to a great extent based. And certainly a theory which has received the support, however qualified, of so eminent a hospital surgeon as Mr. Erichsen, cannot be considered as of no importance.

---

[1] *On Hospitalism*, p. 37.

[2] It is not, of course, meant that pyæmia, for instance, is seen as often in private as in hospital practice, because its causes are less often met with in the former than the latter; but, if due allowance be made for this obvious consideration, there is much reason to acquiesce in the conclusion to which Sir James Paget's ample experience has led him, that pyæmia is just as frequent in private as in hospital practice (*Clin. Soc. Trans.*, vol. vii. p. lvi.) Erysipelas seems to be more frequent and more fatal in private practice than in hospitals.

It is therefore necessary to point out to the reader that the theory, as so stated (and stated quite correctly after Sir James Simpson's writings), is utterly disproved by the experience of all well-managed hospitals, both before and after the introduction of the antiseptic method of dressing wounds. It must be noticed, in the first place, that the basis of the theory was entirely what is called 'statistics'—that is, a hasty inference from figures, showing the results of a large number of cases on either side. Now nothing is more dangerous than to draw conclusions from such figures, which are quite unsupported by any histories of the cases on which they are founded.[2] The success of a surgical operation depends more on the antecedents of the operation than on its consequents, and the healthiness of hospitals depends far more on other circumstances than on their construction, size, or age. Nay, more, the success of surgical operations does not necessarily vary with the healthiness of the hospital. In the healthiest hospital a careless surgeon, house-surgeon, or nurse may make havoc of the major operations while all is going on well with the general run of patients.

For all these reasons, any one of which would be sufficient, the conclusions of Sir James Simpson are to be repudiated, and to be considered the more mischievous because, while they allege imaginary causes of danger, they thereby conceal those which are real and certain, and necessarily induce surgeons and managers of hospitals to overlook details, attention to which is always followed by success in the treatment of grave surgical cases. With such attention, a hospital may be brought into a condition not inferior to the best circumstances under which private practice is carried on.

The writer must not be misunderstood, as if he thought the details of hospital-construction unimportant. The principles of construction which are now accepted for the building of a hospital will be found at pago 879; but it has been shown to demonstration that, provided wards be well, but not excessively, ventilated, and kept perfectly clean, and provided also that the beds are far enough apart, the precise ground plan of the hospital matters little—that the doctrines so much insisted on by the French writers on hospitals as to the superiority of the 'pavilion plan,' as to the unhealthiness of upper storeys and so on, and which have been adopted as if they were unquestionable truths by many writers on the subject, have led to much waste of money on buildings too scattered for hospital service, which have turned out to be no healthier than the more compact and convenient structures which they superseded. But we ought not, in reaction from these exaggerations, to undervalue the importance of good ventilation, good aëration, proper isolation of beds, and, above all, scrupulous cleanliness in hospital wards. These essentials being secured, the writer is persuaded that a hospital may be just as healthy with thirty wards as with three, with twenty patients in each ward as with two, and with five storeys as with one. Far more important, and far too little thought of, till within the last few years, is the amount of attention given to the personal care of the patients. This is particularly the case in the treatment of open wounds. Everyone who has been much in hospitals must have often seen, and especially abroad, surgeons, dressers, and nurses hurry from one patient to another, hardly washing or wiping their instruments, still less their hands, and using the same dressing materials for one case after another. Surgical practice cannot be safely carried on in this way, however healthy in itself the hospital may be. The first care of a surgeon in charge of hospital-wards ought to be to impress upon all his assistants, and never to forget in his own person, that the success of surgical practice depends more upon minute care in the dressing of cases than on all other matters put together. Our surgical wards have become far more healthy since the introduction of antiseptic surgery; and that this must be largely due to the increased care in the minutiæ of surgical treatment which has followed on the discussion of this method is proved by the fact that the improvement is as conspicuous in the practice of some of those who reject, as those who follow, Sir Joseph Lister's teaching.[1]

If it were not true that the septic diseases, or erysipelatous diseases, which interfere so much with the success of operations in our hospitals, depend in a very large proportion of cases on the method of dressing the wound and not on matters conveyed by the atmosphere, how could the success of the so-called

---

[1] *On Hospitalism*, p. 98.

[2] The writer lays less stress on the total absence of any guarantee for the accuracy of Sir James Simpson's table of cases in private practice, and is willing, for the sake of argument, to assume that the figures are correct.

[1] The late Mr. Callender stated it as his deliberate opinion that the great surgical operations were ten times more successful in hospitals than they used to be in the past generation. This was before the general use of Lister's method.

'open method' of dressing wounds be explained? In this method the wound is left freely exposed to that hospital air which is, we are told, charged with deadly miasma. But care is taken to see that the wound is well drained of all putrefiable discharges, and kept perfectly clean. If Sir James Simpson's theory were true, we ought to have an increased mortality following on the freer exposure to this deadly atmosphere. On the contrary, the perfect drainage of the wound, and the care taken to keep it free from all putrefying matters, are followed by results which can hardly be surpassed. Thus Dr. James Wood, of the Bellevue Hospital, New York, relates, that in wards which had been recently vacated on account of an outbreak of puerperal fever, he treated fourteen successive cases of unselected amputation of the limbs successfully, by merely leaving the flaps ununited, the raw surfaces exposed to the air, but carefully drained, and all putrescible matters continually removed;[1] and this is only one of many proofs which have recently been given of the fact that there are many other plans of treating wounds besides that which is specially designated 'antiseptic,' under which, conjoined with proper construction and general management, a hospital may be as healthy as a private house.

This statement, which is made after long experience, and with a conscientious conviction of its truth, by no means asserts that it is *as easy* to keep a hospital healthy as a private sick-room; or, in other words, that the aggregation of the sick and wounded involves no dangers. Such a doctrine would be absurd; but the dangers are the same in kind, and the precautions required are the same, with a single exception. Hospitals, like private houses, must be kept well-aired, well-drained, scrupulously clean, properly, but not excessively, lighted,[2] and so forth. The great difference in the precautions required to ensure the salubrity of hospitals and private houses is, in one word, to guard against direct infection, and this may occur in two ways. Surgically, infection is carried directly by careless dressing—and every hospital surgeon must have remarked that as he himself is more watchful and careful, and as he has the good fortune to be surrounded by more careful assistants, his cases do better; and in the present healthy condition of most of our large London hospitals, such precautions of themselves suffice to raise the success of surgical practice to a level probably higher than it reaches in private houses. The second way in which infection may be carried is by direct proximity or contact. This is more important in medical cases, and the obvious danger of the spread of infectious fevers has led the managers of most of our general hospitals to exclude such diseases from their wards as small-pox, scarlet fever, and typhus, while other affections are admitted, which, though contagious, are so in a less degree, as typhoid fever, erysipelas, diphtheria, &c. Enough, or more than enough, has been done in this direction—that is, the public safety might be as well consulted if typhus and scarlet fever cases were still admitted (as before the institution of special hospitals for such cases they used to be) into the wards of our general hospitals in small numbers, and under strict precautions. Anyhow, it appears that there is little if any evidence of spread of disease from such cases reputed to be infectious as are still to be found in our general hospitals. Hearing that some distinguished surgeons teach confidently that pyæmia and erysipelas are usually propagated by contagion, the writer has often watched the progress of such cases when originating in hospital or admitted from without, but has never been able to verify any spread of the disease from them, though he does not deny the possibility of such an occurrence.

To sum up the whole matter—the writer would define the term 'Hospitalism' as expressing the danger which exists in hospitals of contamination from the aggregation of patients—and would add that the extent to which such contamination prevails has been greatly exaggerated by theoretical writers; that, as far as the general atmosphere of the ward is concerned, the danger may be, and appears in all well-managed hospitals really to be, obviated by ventilation and cleanliness; and the more immediate danger from the contiguity of patients cannot be shown to produce any appreciable effect, while the danger of contamination of wounds by putrefying materials demands constant vigilance to counteract it; but with such vigilance seems to be so far counteracted that hospital practice is probably more successful than private practice in similar cases. In support of this assertion the following facts are submitted.

Phagedæna, pyæmia, and erysipelas, originating in the hospital, are the affections universally admitted as tests of the healthiness of the wards, or (to use Sir James Simpson's words) of the existence of Hospitalism. In reviewing, a short time ago, his own career as assistant-surgeon and surgeon to St. George's Hospital, the writer had occasion to examine the past and present records of its practice—records, he may say, more perfect and more available than exist, as far as he knows, at any other hospital; for detailed notes are preserved of every case, and are so tabulated as to be immediately accessible. First, with regard to phagedæna, whether in the milder form, to which the name is often restricted, or in the more formidable sloughing variety spoken of as 'hospital gangrene,' the affection is now unknown; only three cases having been admitted with venereal phagedæna, and none having broken out in the wards, during a period of five years. Next, with regard to pyæmia, there had been fifteen cases in the wards during three years, eight of which were admitted with the disease. Of the seven cases occurring in the hospital, one was puerperal in a patient admitted for another cause; three after suppurative affections—viz. carbuncular abscess, acute periostitis, and diffuse cellulitis—*i.e.* after various forms of blood-poisoning which had preceded admission; and three only after surgical operations of all kinds, and in one of these (who was under the writer's own care) the diagnosis was doubtful—the man recovered. One of the other cases was an operation for stricture and perineal abscess, where the wound could not be kept aseptic. The last was after an amputation in which the surgeon (who was again the present writer) had probably amputated too near the suppurating tissues. As to erysipelas, a large number of cases of phlegmonous erysipelas were admitted; but there was no record of the outbreak of this disease in the hospital. Cutaneous erysipelas was freely admitted into the ordinary wards, and a few sporadic cases originated in the wards, but almost always of a very mild type. During the two last complete years included in this survey, there had been thirty-one cases on the whole—twenty-three admitted and eight originating in the wards. Only one death occurred out of the whole thirty-one, in a drunkard admitted with scalp-wound. Delirium tremens and erysipelas supervened, and he died in a few days, whether of the delirium or the erysipelas could not be determined.

---

[1] *New York Med. Journ.*, Jan. 1876.

[2] Most of our hospitals are too light, and too destitute of the means of excluding the light. No doubt a flood of light in the ward is very useful in detecting dirt, but it sadly interferes with the repose which many medical and surgical cases require.

There is no reason to believe that other hospitals are in any respect inferior to St. George's, so that there seems fair cause for saying that 'Hospitalism' has no existence in the institutions of the present day in this country, if we are to understand by that term any condition of the hospital which exposes a patient to greater risk after injury or operation than he would run if treated at home. T. Holmes.

HOSPITALS, Administration of.—The administration of a hospital should be so framed as to enforce the necessary economy consistent with the due supply of the requirements for the sick.

Governing Body.—The form of government depends to some extent upon the authority under which the hospital is placed; that is to say, whether the hospital is a foundation or subscription hospital; a hospital established by a municipality or corporation; or a military or naval hospital under the Government.

But there are certain general principles which must in all cases be observed, without which proper discipline throughout the several branches of the administration will not be secured.

The government may be by means of a governor, or by a committee, on which the professional element should be represented. It provides for the general supervision and discipline of the establishment, and for the financial arrangements. It controls the appointment and removal of all members of the staff of the hospital. It makes all general regulations, after consultation with the professional department, as to internal economy, admission and discharge of patients, distribution of beds, dietary, and other matters. It regulates the expenditure. In hospitals supported by subscription, it raises the funds for supporting the institution.

Governor or Treasurer.—In large foundation or subscription hospitals, and in military and naval hospitals, there is a resident representative of the governing body, generally termed Governor or Treasurer, who exercises a general supervision over the structure and the discipline of the establishment.

Secretary or Steward.—The chief executive officer immediately under the governing body is called the Steward, or sometimes the Secretary. He has the control of all servants not included in the nursing staff—such as porters, ambulance-men, engine-man, bath-assistants, and other male attendants. He sees that all structural appliances are in good order, and that cleanliness and discipline are maintained throughout the building. He controls the issue of all orders for the supply of goods, provisions, fuel, &c., and watches that they are used with a due regard to economy. He countersigns all orders for payment after they are passed by the treasurer, and is responsible for the hospital accounts. He sees that the records of admission, discharge, and death are duly kept by the professional staff. He is responsible for the safe custody of clothing, money, and property brought in by the patients, till their discharge. He has charge of the correspondence.

Clerk or Assistant Steward.—The secretary or steward is assisted by an assistant or clerk. This latter receives all provisions and stores, sees that they are correctly delivered, and is responsible for their safe custody until distributed to an authorised person. He sees that the diet-tables are prepared from the prescription-papers, and that the articles of food supplied to patients are strictly in accordance with the diet-tables, or else specially ordered by the physician or surgeon.

Professional Staff.—The professional staff directs the proceedings to be taken for the well-being and cure of the patients. It consists of the consulting and visiting physicians and surgeons; the assistant physicians and surgeons; and the resident and house physicians and surgeons, and assistants continually present in the hospital.

Medical Committee.—The professional staff forms a medical committee with a specified quorum. This committee is consultative only, and should be consulted by the governing body on all matters concerning the medical and surgical departments of the hospital, the admission and discharge of patients, the distribution of beds, the dispensary, the in-patients, the out-patients' department, and the students. The medical committee, moreover, puts forward recommendations for the purchase of instruments, apparatus, and medicines. The committee provides for a descriptive record of cases admitted into the hospital, and for the efficient instruction of students.

Physicians and Surgeons.—The physicians, surgeons, assistant physicians, and assistant surgeons undertake the charge of the wards and out-patients' departments, and attend at the hospital at fixed times. The physicians and surgeons order the diet of the patients; and no article of diet which does not appear in the diet-tables is supplied unless specially ordered by them.

Resident Medical Officers.—The resident medical officers control the treatment of patients in the absence of the physicians and surgeons; and have a disciplinary control over the dressers and clinical clerks. They decide on the admissibility or otherwise of applicants for relief, when not admitted directly by the physicians and surgeons, as well as on the wards in which the in-patients are to be placed, and are responsible for their care until seen by the physicians and surgeons. They visit the wards and dispensary, according to the regulations, to see that the patients are duly attended to. They superintend the conduct of the assistants of the medical officers, and of the dispenser and his assistants, of pupils (if any), and of patients; give notice of any misconduct of the nurses and servants to the matron or lady superintendent; and inform the governor or secretary, the physician, surgeon, and governing body, of any matter requiring their attention. They are responsible that the records of cases are properly made out. In most cases, however, this duty is now performed by *registrars.*

Dispenser.—The dispenser acts under the resident medical officer, subject to regulations laid down by the governing body.

Nursing Department.—The nursing department is under a trained matron, who should be lady superintendent of the training school, and head of all the women employed in the hospital.

Matron or Lady Superintendent.—The whole responsibility for nursing, internal management, care of linen and housekeeping, and the discipline and training of nurses is vested in the trained female head of the nursing staff, by whatever title she be called. To the governing body of the hospital she is responsible for the conduct, discipline, and duties of her nurses. To the governing body and the physicians and surgeons in charge of wards she is responsible for the care and cleanliness of the wards, for the care and cleanliness of the sick, and for the linen. She is responsible to the medical officers that their orders about the treatment of the sick are strictly carried out. To fulfil these responsibilities, she has the power of engaging, appointing, and dismissing all nurses, female servants, and probationers, subject, of course, to the general control of the governing body. The nursing establishment cannot be made responsible on the side of discipline to the medical officers, or the governor of a hospital. Simplicity of rules, placing the nurses in all matters regarding management of the sick absolutely under the orders of the medical staff, and in all disciplinary matters absolutely under the lady superintendent or matron, to whom the medical officers should refer all cases of neglect, is essential to due discipline and efficiency. Any remissness or neglect of duty is as much a breach of discipline as drunkenness or other bad conduct, and can only be dealt with to any good purpose by report to the matron. But neither the medical officer nor any other male head should ever have power to punish for disobedience. His duty should end with reporting the case to the female head, who is responsible to the governing authority of the hospital, as all her nurses and servants, in the performance of their duties, are immediately responsible to the matron only. If the matron or lady superintendent does not exercise the authority entrusted to her with judgment and discretion, it is then the legitimate province of the governing body to interfere and to remove her.

The matron resides in the hospital where her nurses and probationers are at work.

In a hospital of, say, above 300 beds, and with a training school of, say, above twenty probationers (which all such hospitals ought to include), the trained matron should have three trained representatives or assistants—one in the training school as mistress of probationers or *home-sister*; and two in the hospital—one by day as *assistant matron* (or superintendent), and one by night as *night superintendent of nurses*; and of these two the night representative is the more important. Besides the trained assistant matron (superintendent), who should have such inspection of the wards as the matron may commit to her, the matron will require one *linen-assistant and housekeeper*, who might also have the charge and inspection of the nurses' rooms, if the trained assistant matron has not time. She should 'mother' the ward-maids, and have some 'gathering' for them.

Nurses and Servants.—Under the matron there should be distinct grades of nurses, and distinct duties for each grade: 1. Trained chief nurses (ward-sisters). 2. Trained nurses (day). 3. Trained nurses (night), at least equal in pay and status to the day-nurses. 4. Probationers in training. 5. Ward-maids, and nursemaids for children's wards. 6. Dormitory and stairs women. 7. Female cook, and her assistants under the housekeeper. The hospital cook in a large hospital would probably be a man, and under the steward. The sisters, nurses, and probationers would require a female cook, under the matron. All women employed in the hospital should reside in the institution.

Night Superintendent.—The (trained) night superintendent of nurses should be in charge of the night-nursing, in communication with the ward-sisters, as well as of the night-nurses, and should see that the ventilation and temperature of the wards is maintained, as directed by the medical staff. She must be one qualified not only to have charge of nurses and have some 'gathering' for night-nurses by day, but to train probationers told off to accompany her at night, to their own benefit and hers.

Assistant Matron.—The assistant matron is to have special charge over the nurses' rooms, to see that the nurses rise in time to wash themselves, strip their beds, empty their slops, and have breakfast, before going on duty; that later they make their beds and put their rooms in order; that they never wash their own clothes in their own rooms (for all nurses' washing should be done for them); that they go quietly to bed at night, and lights be put out at a certain hour; that their rooms are always clean, in order, wholesome, and cheerful. Without this constant supervision, what is necessary for the nurses' health is not done; the same for night-nurses is yet more important. Nurses' meals should always be presided over by some such authority.

The hospital night-nurses should have two hot meals in the common dining-room—it might be in the probationers' home—say, at 9.30 A.M. and 9.30 P.M., ready and prepared for them. And sisters, staff-nurses, and ward-maids should have, though at different hours—as all cannot be absent from the wards at once—dinner and supper, each set together in a common dining-room, away from the ward air. No nurse should have to prepare her meals for herself.

Laundry.—In small and moderate-sized hospitals, when there is a laundry attached to the hospital, the supervision should be under the lady superintendent or matron. In large hospitals, it would be advisable for the laundry, which should in all cases be in a building entirely detached, to be worked independently, under the general supervision of the governor or secretary.

Chaplain.—The religious care of the patients is generally provided for by the appointment of one or more permanent chaplains, or by visits and religious services of other ministers whom the patients may desire to attend them; subject, however, to the opinion of the medical attendant, as to how far the state of health of the patient will admit of such visits, and to the visits being made at such times as do not interfere with the discipline of the hospital.

DOUGLAS GALTON.

HOSPITALS, Construction of.[1]

—A hospital or infirmary is a building intended for the reception and treatment of sick and injured persons, under conditions favourable for their recovery.

A hospital must be so constructed and arranged as to enable a limited staff of medical men, nurses, and assistants to minister to the necessities of a large number of sick, and to promote their speedy restoration. The conditions essential for such objects are as follows:—

(1) *Pure air.* There should be no appreciable difference in purity between the air inside the wards and that outside the building.

(2) The air supplied should be capable of being *warmed* to any required extent.

(3) *Pure water* should be supplied for internal use, and sufficient also to ensure the removal of impurities to a distance from the hospital.

(4) The most perfect *cleanliness* within and around the building should be enforced.

These conditions depend on—

(1) The *site* of the proposed hospital.

(2) The *form* of the rooms or wards in which the sick are to be placed, so as to ensure purity of air and convenience of nursing; these rooms forming the principal *units of hospital-construction.*

(3) The *distribution of these units*, and of the other accessories which, combined, constitute the hospital.

1. Sites of Hospitals.—The local climate should be healthy, and there should be a free circulation of air over the district. Town sites should be avoided as far as possible. When necessarily placed in a town, a space free from buildings should be reserved on all sides. There should be no nuisances, damp ravines, muddy creeks, undrained or marshy ground, near the site, or in such a position that the prevailing winds would blow effluvia arising from them over the hospital.

---

[1] This article has reference more especially to permanent general hospitals. The principles apply equally to special temporary field or other institutions for 'the cure of the sick.'

The site selected for a hospital should not receive the drainage of higher ground, and the natural drainage outlets should be sufficient. There should, if possible, be no buildings near a hospital except those connected with its object. The number of sick to be allowed per acre will depend practically upon the arrangement of the buildings in which they are lodged.

2. **Form and Distribution of the Parts of a Hospital.**—The structural arrangements of a hospital should be such as to secure free circulation of air.

The Ward.—The basis upon which the structural arrangements rest is the *ward.* The administration, means of access, and discipline must be made subsidiary to the question as to how the sick are to get well in the shortest possible time, and at the least expense; and this, so far as the structure is concerned, is mainly determined by the form of the wards.

Size.—The size of a ward depends upon the number of patients who are to occupy it, and upon the cubic space and floor space which should be allotted to each patient. The disciplinary and economical dispositions in a hospital require that each head-nurse should have the patients allotted to her placed under her immediate eye. Economy of labour requires that the hospital should be so laid out as to enable the largest number of patients to be nursed by a given number of nurses. The *number* to be placed in a ward therefore depends upon the number which can be efficiently nursed; and the form of the ward must be as much calculated to facilitate nursing, as to ensure free circulation and change of air. From twenty to thirty-two beds have been taken as the unit for ward-construction. In hospitals where cases of more than ordinary severity are likely to be received, it would be necessary to diminish the size of the wards on grounds of health. Small wards containing one or more beds are also required for isolating certain cases or for various necessary objects.

Conditions regulating ward-construction. The general form of ward-construction is mainly governed by the question of the renewal of air. The air within an inhabited space, enclosed on all sides, is vitiated by the emanations proceeding from the bodies of those who inhabit it, and especially by the effect on it of their respiration. In all sickness, and all surgical cases, wounds with discharge, or sores, these emanations are greater in quantity, and more poisonous in quality, than from persons in health; whilst, at the same time, most cases—medical and surgical—are more susceptible to these emanations. Stagnation in the movement of the air leads to rapid decomposition of these emanations. If they diffused themselves uniformly throughout the space, which in fact they do not, ventilation would be comparatively simple, and, whatever the cubic space, the air would attain a permanent degree of purity, or rather impurity, theoretically dependent upon the rate at which emanations are produced, and the rate at which fresh air is admitted. Hence the same supply of air would equally well ventilate any space; but the larger the cubic space, the longer it will be before the air in it attains its permanent condition of impurity, and the more easily will the supply of fresh air be brought in without altering the temperature, and causing injurious draughts. The amount of air which should be removed, and its place supplied with fresh air, is at least 3,000 cubic feet per patient per hour; but this must depend to some extent upon the emanations of the patients, which vary with the diseases or injuries they are suffering from. The ventilation of each ward should be kept independent of other wards or rooms.

Means of ventilation.—The change of air may be effected in various ways. For instance, the air may be drawn out by a fan; or it may be removed by a shaft, whose action depends on the difference of the temperature of the air in the shaft and that in the outer atmosphere. Of this the ordinary fireplace is one example; a caldron of water kept boiling for the use of the hospital by a steam pipe is another; a sunlight is a further example; and a heated shaft connected with flues led from holes in the wall near the patients' beds, through each of which air is drawn into the shaft, is another method. Theoretically it is thus quite possible so to arrange the ventilation mechanically that a specified quantity of air at a fixed temperature shall be brought into the ward by day and by night. Practically, however, hospitals dependent upon such means alone for ventilation require an attention which they can rarely or never receive, and, except under favourable circumstances, are not healthy.

The emanations from the body do not uniformly diffuse themselves; they hang about as the smoke of tobacco may be said to do. In wards into which a fixed quantity of air is forced, there is not even a uniform degree of impurity; consequently it is necessary, in order to ensure the purity of the air of a ward, that means should exist for absolutely sweeping out at intervals all the impure air from it, and starting afresh with pure air. This is best effected by the direct action of currents of fresh air brought in by open windows placed on opposite sides of the wards. The distance between windows for this purpose must not be too great to prevent their efficient action in moving the air. Twenty-four feet is a good width, but opposite windows for such an object should in no case be more than from thirty to thirty-five feet apart. The space between the windows should not be obstructed by walls or partitions. The number of patients—that is to say, the sources of impure emanations—placed between opposite windows, should be limited to two rows. In the daytime, and when the weather admits of open windows, a ward with windows opening on both sides can easily be kept fresh; but for other seasons it is necessary to provide openings for the escape of impure air, and for the admission of fresh air which shall not cause draughts.

For the purpose of removal of air, shafts carried up from near the ceiling-level to above the roof are convenient, the lower ends being louvèred to prevent patients feeling down-draughts which may occasionally prevail. The most powerful engine of ventilation for drawing out the air is an open fireplace.

In order to prevent the temperature of the ward from being lowered by the extraction of air, that is, to maintain an equable temperature and to prevent draughts, air warmed to a moderate degree should replace that removed by the fireplace or by other openings. Means for the admission of air in an upward current should be provided direct from the open air, independently of the windows and doors; for this purpose tubes with bends, which favour the collection of dirt, are objectionable. Sherringham's ventilators, which are easily cleaned, placed between the windows near the ceiling, answer well; they admit the air without perceptible draught, and also frequently act as outlets when open on the leeward side of a ward. The external air may be warmed as it enters by being made to pass over hot-water or steam tubes. Openings, if placed close to the floor under the beds, should be capable of being easily and securely closed. All openings for the admission of fresh air should be so placed as to be easily examined and cleaned throughout their whole length, and this should be done at least once a year.

Superficial area.—The next most important element in the question of ward-construction is the superficial area to be allotted to the patients, which is even more important than cubic space, for on this depends the distance of the sick from each other, the facility of moving round the sick, shifting beds, cleanliness, and other points of nursing. In connexion with this it is convenient to allude to the question of circular wards. The circle affords a maximum of area in proportion to the perimeter, whilst the rectangular form affords a large perimeter in proportion to the area. Therefore, with a given floor-space the rectangle affords a large wall-space for the beds, whereas the circular form affords a small wall-space, and the beds must consequently be placed close together, whilst the large part of the area enclosed is in the centre of the ward, away from the beds, which is a disadvantage. If there be a medical school attached to the hospital, the question of area has to be considered with reference to affording the largest amount of accommodation practicable for the teacher and his pupils, without their breathing up the patients' air. A ward with windows improperly placed, so as not to give sufficient light, or where the beds are so placed that the nurse must necessarily obstruct the light in attending to her patients, will require a large floor-space, because the bed-space must be so arranged, and of such dimensions, as to allow of sufficient light falling on the beds. In well-constructed wards with opposite windows, the greatest economy of surface-area can be effected, because the area can be best allotted with reference both to light and to room for work. In a ward 24 feet in width, with a window for every bed or every two beds, a 7 ft. 6 in. bed-space along the walls would probably be sufficient for nursing purposes. This would give 90 square feet per bed, and there should be as little reduction as possible below this amount for average cases of sickness; but this space is much too small for surgical, fever, or lying-in wards, which should also be for a much smaller number. The Herbert Hospital, without a medical school, has 99 superficial feet per bed; St. Thomas' Hospital, with a medical school, has 120 superficial feet per bed. The bed-space should be larger if the locality is less healthy.

The area allotted to patients practically settles the cubic space, because wards should not be less than 12 feet high, though as a rule they need not exceed 14 feet in height.

In a good situation, and for ordinary cases of disease, those spaces which are enough for nursing and for ward-administration would, with good ventilation, be sufficient for all sanitary purposes; but for such cases as typhus or other infectious diseases, operations, and bad surgical diseases, a larger space and area would be required. When severe cases of this class come into an ordinary hospital, the simplest plan is to leave the bed vacant adjacent to that occupied by the patient.

Lying-in wards should never contain more than from one to four beds. In recent French hospitals these wards contain one bed each, and the only access to them is from an open verandah and through a small ante-room. Ovariotomy, and other operations of the like risk, should be performed in a one-bed ward. When space permits, a room may be provided for the use of patients when convalescent, and able to be temporarily absent from the wards. The same observation applies to grounds for outdoor exercise. But separate convalescent hospitals or homes are better, both for health and discipline. If hospitals are provided for special infectious diseases, every patient should be placed in a separate hut-ward. Cleanliness and abundance of fresh air is the best safeguard against infection.

Materials.—With a view to economise heat in winter, and to keep the rooms cool in summer, the walls should be hollow, and all wards should be ceiled, unless the roof is constructed of a good non-conducting material. The best lining for a hospital-ward is an impervious polished surface, which on being washed with soap and water, and dried, would be made quite clean. Plaster, wood, paint, and varnish all absorb the organic impurities given off by the body. Parian cement polished is the best material at present known for walls, but it is costly, and it can only be applied on brick or stone walls, and not on woodwork, because, being inelastic, it is liable to crack. Cracks in a hospital ward are inadmissible, as they get filled with impurities, and harbour insects. The numerous joints required for glazed bricks, or tiles, render the use of these questionable for wards. In default of Parian cement, the safest arrangement is plaster lime-whited or painted, which should be periodically scraped, and be then again lime-whited or painted.

The *floor* should be as non-absorbent as possible, and for the sake of warmth to the feet it must in this country be of wood. Oak, or other close hard wood, with close joints, oiled and beeswaxed, and rubbed to a polish, makes a very good floor, and absorbs little moisture. The joints should be like those of the best parqueterie, affording no inlet for dirt. There should be no sawdust, or other organic matter subject to decay, under the floor. When a ward is placed over another, it is essential that the floor should be non-conducting of sound, and that it should be so formed as to prevent emanations from patients in the lower ward passing into the upper wards. Practically, with care, a well-laid oak floor, with a good beeswaxed surface, can always be kept clean by rubbing.

There should be as little *woodwork* as possible in a ward, besides the floor; and what woodwork there is should be varnished, so as to admit of easy washing and drying. The cleanest and most durable material is varnished light-coloured wainscot oak or teak.

The form of the *windows* must be considered, in their aspect of affording light as a necessary means of promoting health, of affording ventilation, of facilitating nursing, and of enabling the patients to read in bed. Light can always be modified for individual patients. In order to give cheerfulness to the wards, and to renew the air easily, the windows should extend from within 2 feet or 2 feet 6 inches from the floor—so that the patients can see out—to within 1 foot from the ceiling. An end window to a long ward is an element of cheerfulness, and materially assists the renewal of the air at night. It is essential to cleanliness that every part of the ward should be light. One superficial foot of window-space to from 50 to 55 cubic feet of space, will afford a light and cheerful room, but this depends much on aspect and upon the walls being light-coloured. To economise *heat* in wards, it is desirable to make the windows of plate glass; double windows of ordinary glass would secure the same object and facilitate ventilation, but they are troublesome to clean, and give a gloomy appearance to a room. The best form of sash for ventilation in this climate is the ordinary sash, opening at top and bottom; but windows made in three or four sections, each of which falls inwards from an axis at the bottom of the section possess many advantages for hospitals.

Ward-offices.—The ward-offices are of two kinds:—

(1) Those which are necessary for facilitating the nursing and administration of the wards, as the *head-nurse's room and ward-scullery.*

(2) Those which are required for the direct use of the sick, so as to prevent any unnecessary processes of the patients taking place in the ward; as, for instance, the *ablution-room*, the bath-room, the water-closets, urinals, and sinks for emptying slops. There ought to be, in addition to the bath-room here mentioned, a general bathing-establishment attached to every hospital, with hot, cold, vapour, sulphur, medicated, shower, and douche baths. Hot and cold water should be laid on to all ward-offices in which the use of either is required, because of the economy of labour in the working of the hospital. For the same reason, when the wards are on two or more floors, lifts should be provided to carry up coals, trays, and patients. The ward-offices should have ample window-space. There should be no dark corners or closed spaces under sinks. Nothing should be kept in these offices which is not in constant use, and everything in use should be open to inspection. All fittings should be light-coloured, so as to show dirt.

(1) The *head-nurse or sister's room* should be sufficiently large to contain her bed and to be also her sitting-room. It should be light, airy, and well-ventilated. It is necessary to discipline that it should be close to the ward-door, and that it should when practicable have a window looking into the ward. If the head-nurse has two wards to supervise, her room should be placed between the two, with a window opening into each.

There should be a *ward-scullery* to each ward, and so situated as to be under the head-nurse's eye. The scullery should be supplied with efficient simple apparatus for its purposes: there should be a small range for ward-cooking, so that the nurse can warm the drinks, prepare fomentations, &c. Shelves or racks should be provided. There should also be a small larder, with free circulation of air, for temporarily keeping provisions fresh. In the scullery, or adjacent to it, a hot closet should be provided for airing clean towels and sheets. Foul linen should not be retained near the wards, or in the hospital building. It should all be placed in baskets, on wheels, and conveyed as soon as possible to the laundry. Ward sweepings and refuse should similarly be placed in movable receptacles, and taken out of the building with as little delay as possible; structural provision for the retention of these in or near the hospital is undesirable.

(2) The *ablution-room*, *water-closets*, *&c.*, ought to be as near as possible to the ward, but cut off from it by a lobby, with windows on each side, having its ventilation and warming distinct from that of the ward and that of the ward-offices, so as to prevent the possibility of foul air passing from the ward-offices into the wards. The ward-offices will be most conveniently placed at the end of the ward farthest from the entrance and nurse's room; and distributed at each side, so as to enable the ward to have an end window. In this arrangement the ablution-room would be on one side of the ward, and should contain a small bath-room with a fixed bath of copper, supplied with hot and cold water. A lavatory-table of impervious material, such as slate or common marble, with a row of sunk porcelain basins with outlet tubes and plugs, each basin supplied with hot and cold water, should be placed in the same compartment as the bath, but separated from it by a partition and door. There should also be room for a portable bath for each ward; and there should be a sink on the floor-level for running off the water from the bath after it has been used.

On the other side of the end window of the ward would be placed the *water-closets*. These should never be against the inner wall, but always against the outer wall of the compartment in which they are placed. A pan of a hemispherical shape, never of a conical shape, with a syphon, abundantly supplied with water to flush it out all round with a large forcible stream, is the best contrivance for the water-closet of a hospital. The urinal should be of a shape to be easily cleaned. The sink for slops, bed-pans, expectoration-cups, &c., which should have a compartment of its own adjoining the water-closets, should be a large, deep, round, pierced basin of earthenware, with a cock extending far enough over the sink for the stream of water to fall directly into the vessel to be cleaned, and with an ample supply of water in a full stream; this sink should be so arranged as to be flushed out like a water-closet pan, and it should be so placed as to make it unnecessary for male patients to pass the nurse on their way to the w.c. There should be a special receptacle near the sink, ventilated to the outer air, for keeping chamber utensils, &c., for the examination of the medical officer.

Walls of ablution-rooms and water-closets should be covered with white glazed tile, slate (enamelled or plain), or Parian cement; plaster is not a good covering for them on account of their liability to be splashed, and of the necessity for their being frequently washed down. There should be separate private water-closets for the nurses; and also water-closets for the patients when in day-rooms or recreation-grounds. The ablution-room and water-closets should be supplied with plenty of fresh air, warmed when necessary, and abundance of light, so as to ensure there being no dark corners. Three water-closets per ward will suffice for a ward of thirty-two beds, but two at least will be required for even a twelve-bed ward.

The water-supply should provide, in addition to pure water for general consumption, a service of distilled water for dressings and such-like purposes.

3. Aggregation of Ward-Units in the Construction of a Hospital.—The principles upon which these units of hospital-construction, or, as they are generally termed, pavilions, when so constructed, should be aggregated, are as follows:—

(1) There should be free circulation of air between the pavilions.

(2) The space between them should be exposed to sunshine, and the sunshine should fall on the windows, for which purpose it is desirable that the pavilions should be placed on a north and south line.

(3) The distance between adjacent pavilions should not be less than twice the height of the pavilion reckoned from the floors of the ground-floor ward. This is the smallest width between pavilions which will prevent the lower wards from being gloomy in this climate; where there is not a free movement of air round the buildings, this distance should be increased.

(4) The arrangement of the pavilions should be such as to allow of convenient covered communication between the wards, without interfering with the light and ventilation, and therefore the top of the covered corridor uniting the ends of pavilions should not be carried above the ceiling of the ground-floor wards. Each block of wards—that is, each pavilion—should have its own staircase.

(5) No ward should be so placed as to form a passage-room to other wards.

(6) As a general rule, there should not be more than two floors of wards in a pavilion. If there are three floors or more, the distances between the pavilions become very considerable because of the rule already mentioned, which ought to be absolutely observed, which regulates the distance at which the pavilions must be kept apart. Besides, when two wards open into a common staircase, there is, with every care, to some extent a community of

ventilation; this will prevail even if the staircase be furnished with permanent openings to the outer air. When there are as many as four wards one over the other, the staircase becomes a powerful shaft for drawing up to its upper part, and thence into the ward, the impure air of the lower wards. Similarly, heated impure air from the windows of the lower wards has occasionally a tendency to pass into the windows of the wards above. For the same reason the upper floor over the wards should not be used as a dormitory for nurses. Similarly, if there is a basement under sick wards, it should not be used for any purpose, such as cooking, or for the reception of perishable stores, from which smells could penetrate into the wards; and it is best not to continue the staircase into the basement, for with every care the basement will always form a receptacle for ground air, which should be kept out of the hospital if possible.

There is a limit to the numbers which should be congregated under one roof. This limit will depend very much on the nature of the cases. In town hospitals, a double pavilion should not contain above 80 to 100 beds.

The size of any given hospital ought not to be determined by increasing the number of beds in any one building, but by increasing the number of units or wards. So far as the sick are concerned, they would be better placed in single detached wards; or, for convenience of administration, in wards all on one floor—opening out of a common corridor. But on town sites the cost of land makes it absolutely essential to build hospitals as compactly as possible; moreover, economy in the current expenses will be best secured by a building with wards on two or more floors, provided with lifts and other labour-saving appliances.

In addition to the larger wards, it is necessary, as already stated, to have a few wards of one or two beds each for special cases.

Corridors should connect the pavilions on the level of the lower floor of wards only. They should be kept as low as possible, so as not to impede the circulation of air between the pavilions; they should be lighted by windows on both sides, opening widely, or removable in warm weather; and they should be provided with ample means of ventilation, and with fresh warmed air in cold weather, so as to prevent draughts.

The *staircases* should be treated similarly as to light and ventilation, and it is desirable to cut off the connecting corridors from adjacent staircases by swing-doors. These arrangements prevent draughts, and cause the passages and staircases effectually to cut off the ventilation of one pavilion from that of another.

The staircases for patients should be broad and easy; the rise of each step should not exceed four inches in height, and the tread should be at least one foot in width; there should be a handrail on each side, and a landing after every six or eight steps provided with seats. The patients in their beds may be wheeled on to the roof of the corridors between the pavilions, or on to a broad balcony outside the end window of the ward, in fine weather.

4. **Administrative Buildings.**—The necessary subsidiary accommodation may be briefly described.

Operating-rooms, dispensary, and school. These should include examining-room, surgery, drug-store, and operating-theatre; the latter having roof-light from the north, and being of easy access to the surgical wards; there being one theatre for male, and one for female patients. Special wards for such cases as ovariotomy should contain but one bed. A dead-house and *post-mortem* room, with ample means of cleanliness, should be provided, quite outside, and detached from the hospital. Where a school is to be established, the necessary lecture-rooms, laboratories, dissecting-rooms, &c., should be kept entirely separate from the building for the sick.

All rooms should be plain, and without projections or ornaments, which form a resting-place for dust.

Officers' quarters.—Apartments for the resident physicians and surgeons, matron, nurses, and servants should not, if practicable, be placed under the same roof with the sick. All the rooms should be light and airy. The resident physicians and surgeons should have each a bedroom and sitting-room, with proper convenience adjacent; and a dining-room for joint use.

The dispenser, if resident, requires a bedroom and sitting-room. An office is required for the steward (purveyor or financial officer), and a room for meetings of the governing body. Each ordinary nurse should have a separate bedroom—neither bare, tarnished, nor dismal; where she may obtain pure air while she sleeps—the night nurses' bedrooms being apart, where they may not be disturbed by noise. There should be bath and closet accommodation near; but each woman should be allowed a washstand and foot-bath in her own room. The head-nurse or 'sister' sleeps in her own room, overlooking her ward; but if there is no common-room, she would have better health if a small sitting-room, as well as bedroom, could be given her off her ward. The head-nurses or 'sisters' should have a dining-room, and also a comfortable, well-furnished sitting-room. They will work better in their wards if they themselves are made comfortable. For sisters and nurses nowadays are, or ought to be, educated women. It is most undesirable that they should seek necessary amusement all out of doors. Nurses should dine in the sisters' dining-room, but at a different hour; and in a large hospital there would probably be required an additional dining-room for ward-assistants. In hospitals with an establishment for training nurses, which every large hospital ought to have, the probationers or pupil-nurses (in a proportion not exceeding one to every ten or twelve patients) would live in a 'Home' under the hospital roof, and under the direction of the hospital matron.

The 'Home' should consist of—(1) Class-room and nurses' library, large, airy, and convenient. (2) One or two dining-rooms, in which sisters and nurses might also dine, and pantry adjoining. (3) Two rooms and an office for the 'home sister' (class mistress). (4) One separate bedroom for each probationer, sufficient to contain press, table, chair, bookshelf, washstand, bedstead, and arm-chair.

Each floor should have a bath-room and other conveniences. Bedrooms for probationers on night duty should be cut off from the noise of the 'Home.' There should also be provided—one sick room; one visitors' room; and servants' offices and bedrooms for cook and other necessary servants.

Stores for bedding and linen, kitchen and provision stores.—The kitchen and all those stores between which and the wards there is a constant movement, should be as central as possible, so as to save labour; but the kitchen should be carefully cut off from the corridor connecting the pavilions. Attached to the kitchen should be a good scullery, larder, and serving conveniences. There should be a large, well-aired, well-lighted, well-warmed, well-arranged linenry and mending-room. The hospital laundry should be detached from the hospital. Special care should be taken to make the laundry buildings airy and very light, with ample means of ventilation for removing the steam, which is heavily charged with organic impurity, and with ample space for the washers. They should have separate drying and ironing rooms.

Out-patients' department.—Those hospitals which afford outdoor relief require a dispensary for outdoor sick. This should always have an entrance separate from the hospital, and should never be under or near a ward, or in the space between adjacent wards. It is placed in proximity to the hospital, for the convenience of the medical men, and medical school (if any), and in order to be near the drug-store and apothecary's shop; but it should be entirely detached, with a free air-space between, and no direct communication be possible.

The out-patients' department requires a large airy waiting-room, with separation of sexes, and separate closet accommodation for males and females, which, without great care, may (even when detached) become a nuisance to the sick-wards; a consulting-room for each of the physicians and surgeons, to which should be attached a small lavatory, and all necessary convenience for the complete examination of patients. The out-patients' department of children's hospitals requires more care, and more ample space in waiting-rooms, because each patient is brought by its nurse. The entrance and exit should be through different doors.

In every large hospital should be provided a well-ventilated chapel, capable of being well warmed.

The position and general construction of the administrative buildings should be made quite subservient to the accommodation for the sick, and to the broad general principle that these buildings should not interfere with the circulation of the air around, or the light of, the wards. DOUGLAS GALTON.

HOT SPRINGS, in Bath County, Virginia, U.S.A.—Thermal waters. *See* MINERAL WATERS.

HOT SPRINGS, in Garland County, Arkansas, U.S.A.—Thermal waters. *See* MINERAL WATERS.

HOWICK, in Natal.—*See* AFRICA, SOUTH.

HUM, VENOUS.—A continuous murmur heard in the veins, generally observed in cases of anæmia. *See* ANÆMIA; and PHYSICAL EXAMINATION.

HUMID (*humidus*, moist).—Moist: in contradistinction to *dry*. Applied to *râles* (*see* PHYSICAL EXAMINATION); to characterise a variety of asthma attended with expectoration (*see* ASTHMA); and also to particular climates. *See* CLIMATE, The Treatment of Disease by.

HUMORAL (*humor*, a humour).—Of or relating to the humours. Chiefly used as a term for a pathological doctrine—the *humoral pathology*—which associates all diseases with morbid states of the fluids of the body (*see* BLOOD-DISEASE). The word is also sometimes employed as synonymous with *humid*, when applied to asthma.

HUNYADI JANOS, in Hungary. Sulphated waters. *See* MINERAL WATERS.

HYDATIDS.—*See* ENTOZOA.

HYDATIDS, UTERINE.—*See* MOLE. MOLAR PREGNANCY.

HYDRÆMIA (ὕδωρ, water; and αἷμα, the blood).—A watery condition of the blood. *See* ANÆMIA; and BLOOD, Morbid Conditions of.

HYDRAGOGUES (ὕδωρ, water; and ἄγω, I drive).—SYNON.: Fr. *Hydragogues*; Ger. *Wassertreibende Mittel.*

DEFINITION.—Purgative medicines which cause a copious watery discharge.

Enumeration.—Hydragogue purgatives include:—Bitartrate of Potassium, Buckthorn, Colchicum, Colocynth, Croton Oil, Elaterin, Gamboge, Hellebore, Jalap, Podophyllin, and Scammony. The two most important are Compound Jalap Powder and Elaterin.

Action.—It has been supposed by some writers that the action of the drugs included in the present class is due only to the increased peristaltic action which they produce. This, however, is not the case, as certainly some, if not all, of those just enumerated induce a free secretion of fluid by the intestinal mucous membrane, while at the same time they stimulate the peristaltic action of the bowel, and cause the evacuation of this watery fluid.

Uses.—Hydragogues are chiefly employed for the removal of fluid from the body, in cases either of general anasarca or of dropsical effusion in serous cavities. They may be employed to assist the action of the kidneys when this is insufficient; and it has been observed not infrequently, when the secretion of urine has previously been deficient, that it becomes greatly increased after a free discharge of fluid has taken place from the bowels, in consequence of the administration of a hydragogue cathartic. *See* Purgatives. T. Lauder Brunton.

HYDRARGYRIASIS (*hydrargyrum*, mercury).—The state produced by the introduction of mercury into the system. *See* Mercury, Poisoning by.

HYDRARTHROSIS (ὕδωρ, water; and ἄρθρον, a joint).—Effusion of a serous fluid into a joint. *See* Joints, Diseases of.

HYDROA.—Synon.: Fr. *Hydroa bulleux*; *Pemphigus pruriginosus*; *Herpes gestationis.*

The term 'hydroa' was applied by Bazin to three different eruptions which he called respectively, *vesicular hydroa*, *bullous hydroa*, and *vacciniform hydroa*; the last of these has not been recognised by any other writer. Vesicular hydroa is now known to be identical with erythema iris, in which vesicles or small blebs are developed (*see* Erythema). Therefore hydroa is at present limited to the hydroa bulleux of Bazin.

Symptoms.—The disease is a severe and rare one; it is attended with much eruption, great itching, and more or less constitutional disturbance. Pregnancy seems in some way to favour its development—hence the name, *herpes gestationis.* The eruption consists of blebs, mixed with pruriginous papules, somewhat resembling those of prurigo. The blebs resemble those of pemphigus, but their average size is smaller and more variable than in the latter disease; the resemblance, however, induced Hardy to name the disease *pemphigus pruriginosus.*

Differential Diagnosis.—Hydroa should be distinguished from pemphigus, prurigo, and erythema iris. From pemphigus it is distinguished (1) by the relatively small and unequal size of the blebs; (2) by the presence of pruriginous papules, and the intense pruritus which is often present; (3) by the constitutional symptoms, which, though sometimes severe, are less than in cases of pemphigus attended with equal amount of eruption; (4) by the disease not being amenable to arsenical treatment to anything like the same extent as pemphigus.

It is only when the blebs are absent or but little developed that hydroa could be mistaken for prurigo. The relatively acute nature of the disease, and the history of the case would greatly aid the differential diagnosis.

Erythema iris with blebs is probably the disease which is most nearly allied to hydroa; but in the latter the blebs are a chief and characteristic feature, whereas in erythema iris they are, so to speak, accidental and ephemeral. The pruriginous papules and intense pruritus are, moreover, not present in erythema. Altogether, hydroa is a much more severe disease.

Treatment.—Alterative aperient remedies may be required; and attention should be given to diet. Arsenic has not been found generally useful, though cases are occasionally met with in which it appears to do some good. Quinine is certainly a more useful tonic. Various local remedies, such as linimentum calcis made with almond oil, or carbolised oil and zinc ointment, may be tried to relieve the irritation of the skin.

Robert Liveing.

HYDROCARDIA (ὕδωρ, water; and καρδία, the heart).—An effusion of serous fluid into the pericardial sac. *See* Pericardium, Diseases of.

HYDROCELE (ὕδωρ, water; and κήλη, a tumour).—Synon.: Fr. *Hydrocèle*; Ger. *Wasserbruch.*

Definition.—A swelling produced by a collection of fluid in connexion with (A) the testicle, or (B) the spermatic cord.

A. Hydrocele of the Testicle.—The principal forms of hydrocele of the testicle are (1) the *vaginal*, (2) the *congenital*, and (3) the *encysted*; (4) *chylous*, (5) *bilobular*, and (6) *diverticular* hydrocele will also be noticed.

1. Vaginal Hydrocele.—Description. This is a chronic dropsical effusion into the sac of the tunica vaginalis. The fluid is a pale-yellowish serum, which in old cases is often loaded with cholesterine. The quantity varies, but seldom exceeds twenty ounces. The writer (T. B. C.) has removed as many as forty-eight ounces. The testicle is usually situated at the back part and rather below the centre of the sac; but its position may be altered by adhesions; and, in cases of congenital inversion, the tetsicle is in front of the sac. In old hydroceles the sac is often greatly thickened by deposition of lymph on the tunica vaginalis, and its conversion into fibrous tissue, which is sometimes the seat of calcareous deposits. It is generally single, but often occurs on both sides. Vaginal hydrocele forms an oval or pyriform swelling, which fluctuates; has a smooth, even surface; and commences at the lower part of the scrotum, very gradually and without pain. When examined by transmitted light it is found to be translucent, except at the back part, where the testicle is situated. Owing to the tunica vaginalis remaining unobliterated for some distance along the cord, the swelling occasionally assumes an elongated form, and extends up towards the inguinal canal. A hydrocele sometimes varies in size, becoming larger and more tense during the day than when the patient first rises in the morning.

Ætiology. — Hydrocele is a common disease, especially in warm climates; and occurs at all periods of life, but is most common in middle age.

Diagnosis.—The circumstances—that the swelling commences below; that the spermatic cord can be detected above the tumour; that the testicle cannot be felt; and that the tumour receives no impulse on coughing, and does not vary in size on pressure—are signs distinguishing a hydrocele from an inguinal rupture. When the sac is much thickened, so as to obscure fluctuation, and prevent the passage of rays of light, the tumour may be mistaken for a hæmatocele, or disease of the testicle, and the diagnosis is difficult.

Treatment.—In *infants*, vaginal hydrocele usually disappears under the application of weak tincture of iodine or, as this may irritate the skin, of some evaporating lotion. Acupuncture, causing the fluid to escape into the areolar tissue of the scrotum, is the only operation that is required.

In the *adult* external remedies are of no use. It is usual to resort at once to operative treatment, *palliative* or *radical*. The *palliative* operation consists in puncturing the tumour with a trocar, and evacuating the fluid accumulated in the tunica vaginalis. The hydrocele usually returns in the course of two or three months, and then the operation must be repeated, or the patient must undergo *radical* treatment. This may be effected by incision or excision of the sac; by the passage of a seton; or by injection of the sac with a stimulating fluid. The latter is the plan commonly resorted to; and the fluid almost invariably employed is the tincture of iodine. The only apparatus required, in addition to a medium-sized trocar, is a glass syringe. The surgeon generally injects about a drachm of strong tincture, which he leaves in the sac. The Pharmacopœial preparation is not sufficiently strong. Half a drachm of iodide of potassium, and 40 grains of iodine, dissolved in one fluid ounce of rectified spirit, as an injection, is generally successful. It causes considerable pain, extending to the loins; but all suffering may be prevented by ether or chloroform inhalation. The iodine acts as a stimulant, stirring up mild inflammation, and causing a rapid return of swelling, which gradually subsides until the patient is cured. Instead of this solution, 30 to 60 minims of pure carbolic acid liquefied with 10 per cent. of glycerine have been injected with a successful result, but a permanent cure has not been obtained in all cases where this agent has been employed. Compression with strapping helps the absorption. In double hydrocele, injection may be performed on both sides at the same time. Injection rarely fails to cure the hydrocele. If it does not succeed, the injection may be repeated, and very often proves effectual, but if not, recourse can be had to the seton; or, in cases of thickened sac, to incision or excision.

2. **Congenital Hydrocele.**—In children, the original communication between the cavities of the peritoneum and of the tunica vaginalis sometimes fails to be obliterated; and fluid accumulated in the sac constitutes the variety termed congenital hydrocele. The communication is usually small in size.

Diagnosis.—Congenital hydrocele is easily distinguished from ordinary hydrocele by the absence of a defined boundary on the upper part of the tumour; by the impulse received on coughing; and by pressure causing the disappearance of the swelling, and rendering the testicle perceptible. It is distinguished from a reducible hernia by the fluctuation and transparency of the swelling; by the absence of gurgling accompanying its disappearance on pressure; and by the slow return of the swelling on the patient assuming the erect posture.

Treatment. — Congenital hydrocele is readily cured by the gentle pressure of a truss on the inguinal canal, so as to occasion obliteration of the neck of the sac, after which the fluid usually becomes absorbed.

3. **Encysted Hydrocele.**—In this form of hydrocele fluid is effused into an adventitious cyst distinct from the vaginal sac, developed in the areolar tissue beneath the visceral portion of the tunica vaginalis investing the head of the epididymis. There may be two or even more such cysts. As the cyst enlarges, the epididymis becomes flattened and displaced to one side, whilst the testicle is found either in front or at the bottom of the cyst. The fluid contained in the sac differs from that of vaginal hydrocele in being less in quantity, perfectly limpid and colourless, and nearly free from albumen. The fluid sometimes contains spermatozoa in great abundance, rendering it opaque and milky-looking. Their presence may be owing to the

rupture of one of the tubes of the epididymis, and the escape of semen into the sac of the hydrocele. More probably, the spermatozoa-containing cysts are due to dilatation of one or more of the vasa efferentia in consequence of stricture; and those that contain limpid fluid may be developed from the organ of Giraldès.

Diagnosis.—An encysted hydrocele is distinguished from vaginal hydrocele by the position of the testicle at the bottom of the tumour; and generally by the colourless character of the fluid evacuated.

Treatment.—When large in size, so as to be inconvenient, encysted hydrocele may be treated in the same way as vaginal hydrocele, and injection is attended with the same success.

4. **Chylous Hydrocele.**—Synon.: Chylocele; Galactocele; Liparocele; Fr. *Hydrocèle laiteuse ou graisseuse.*

Description.—Chylous hydrocele may be bilateral or unilateral. It is seldom met with in temperate climates. The writer (J. McC.) has seen only one case. It was unilateral, and the patient had lived for many years in India. It occurs more frequently in tropical countries, where it is sometimes associated with elephantiasis of the scrotum. It is not translucent, but it otherwise resembles an ordinary hydrocele. When it is tapped, a fluid resembling milk is evacuated, which, examined microscopically, proved in the writer's (J. McC.) case to be a very fine emulsion without any formed elements. In other cases a few blood-corpuscles, coloured and colourless, have also been seen. The fluid is neutral, and sometimes coagulates spontaneously.

The occasional association of chylous hydrocele with elephantiasis of the scrotum, and the discovery in many cases of the filaria sanguinis hominis in the fluid, indicate that it is due to this parasite. Blocking of the lymphatic glands and vessels connected with the testicle by this worm is easily conceivable, but no demonstration would appear to have yet been made of a communication with the chyliferous vessels. *See* Filaria Sanguinis Hominis.

Two of the recorded cases of chylous hydrocele appear to have resulted from injury, but in the great majority of cases there has been no history of traumatism, and the fluid most probably transudes as in ordinary hydrocele.

Treatment.—Tapping is merely palliative, as the fluid soon re-accumulates. In one case, at the third tapping the fluid was of the ordinary serous nature, but this result appears to be unique. Injection with solution of iodine is usually successful. If it fail, incision, with drainage, or excision of the sac may be performed.

5. **Bilobular Hydrocele.** — Synon.: *Hydrocèle en bissac* (French surgeons).

Description.—This disease may be altogether outside, or partly inside and partly outside, the abdomen. The formation of the former variety is easily explicable. The *processus vaginalis* may be closed completely at the internal abdominal ring, and partially at its connexion with the *tunica vaginalis propria,* the intervening part remaining open. If in such a condition a hydrocele develop, it will form two sacs, continuous internally, and marked at their junction externally by a constriction, the depth of which will vary inversely with the size of the opening between the sacs. It will be a combination of a *funicular* and a *vaginal* hydrocele, with a communication between the sacs. The diagnosis cannot present any difficulty, and the symptoms, possible results, and treatment will not differ from those of an ordinary hydrocele of the *tunica vaginalis propria.*

For the formation of the other variety, where one sac is inside and the other outside the abdomen, two hypotheses are possible. It may result from some congenital malformation of the *processus vaginalis*, or this process may be closed at the internal abdominal ring, and, if a hydrocele subsequently develop, a diverticulum may be formed at the upper part of the process, and experience less resistance to its extension in the subperitoneal tissue than in the inguinal canal or the *tunica vaginalis communis.*

This form of bilobular hydrocele has been observed at birth, and the great majority of recorded cases have been in patients under forty years of age; but it may develop or become manifest at a later age. Some cases have been complicated with retention of the testicle within the abdomen or in the inguinal canal, but in others the gland has been in its normal position. The intra-abdominal sac may vary greatly in size. In one case it was not larger than a hazel-nut; in another it extended above the level of the umbilicus and beyond the median line of the abdomen. It is usually situated between the peritoneum and the iliac fascia, but in one case it was between the peritoneum and the *fascia transversalis.* The external sac may also vary in size. Sometimes it is small, and limited to the *processus vaginalis*; but when the *tunica vaginalis propria* is also involved, the sac may be very large. When the contents of the sac are serous, the patient does not experience any greater inconvenience than with an ordinary hydrocele. But there appears to be in these cases a great tendency to the formation of a hæmatocele, and the intimate relation of the internal sac with the peritoneum may then become very important.

Diagnosis.—When the intra-abdominal sac is large and causes a projection of the abdominal wall, attention cannot fail to be directed to it, and pressure over the abdominal swelling will produce increased tension of the external sac, and *vice versâ*. But if the intra-abdominal sac be small, or lodged deeply in the iliac fossa, or extend into the pelvis, it may escape notice; but the reducibility, partial or complete, of the contents of the external sac and the *immediate* reappearance of the swelling when the pressure has been removed, ought to suggest the possibility of an intra-abdominal sac. Careful palpation, when the patient has been anæsthetised, will detect some fulness in the iliac fossa; and if the sac has extended into the pelvis, digital exploration through the rectum will aid the diagnosis.

TREATMENT.—The treatment will depend upon the size of the communication between the sacs, the nature of their contents, and their walls. If the communication be free, the contents serous, and the walls thin, tapping the external sac will empty the internal sac also, and injection of iodine solution or carbolic acid in glycerine will probably effect a cure. But if the communication be very narrow, tortuous or valvular, if extravasation of blood has occurred, or if the walls of the sacs be thick, operative treatment varying with the nature of the case will be requisite.

6. **Diverticular Hydrocele.** — This variety of hydrocele is also bilobular, but is altogether scrotal. It was first described by Béraud in 1856, who showed by dissection that the *tunica vaginalis propria* sometimes has very small diverticula. If a hydrocele form, one of these diverticula may become larger and protrude through some accidental rupture or inherently weak part of the *tunica vaginalis communis*. This protrusion might subsequently become so distended as to form the chief part of the swelling.

The *diagnosis* of this condition during life must be very uncertain. The form might be unusual, and the coverings would be very thin, so that translucency would be very marked. If the hydrocele be not tense, it is said that pressure will convey to the hand of the observer a sensation of fluid passing from the diverticulum into the parent sac. It is practically unimportant, for the *treatment* is similar to that of ordinary hydrocele.

B. HYDROCELE OF THE CORD.—Hydrocele occurs in the spermatic cord in two forms—*diffused* and *encysted*.

The **diffused**, which is very rare, is simply an œdema of the areolar tissue of the cord.

Encysted hydrocele of the cord arises from a collection of fluid in the unobliterated funicular process of peritoneum, which is carried down in the natural transition of the testicle. It produces a small swelling in the cord, of an oval form, above and distinct from the testicle, more or less transparent, and quite movable. The swelling, when small, is of no importance; and it seldom requires treatment. *See* TESTES, Diseases of.

T. B. CURLING. JEREMIAH MCCARTHY.

HYDROCEPHALOID DISEASE.—This term is one which has been applied to a set of symptoms, ill-defined in their mode of grouping, occasionally met with in delicate children soon after they have been weaned. The symptoms may in some cases have been due to reflex disturbance of the nervous system induced by improper food; they may appear as the sequence of some exhausting disease, such as a prolonged diarrhœa; or they may be concomitants of a pneumonia in its initial stages. In each of these, as well as in other allied conditions, there may be a febrile elevation of temperature; combined, in the first place, with undue irritability and extreme restlessness, whilst later on signs of mental sluggishness and stupor may supervene. Such symptoms are apt to be met with where, in addition to a depression of the vital powers, there is a reflex disturbance of brain-functions. The condition was specially described by Marshall Hall, by whom the above name was given. It may be well, therefore, to quote from his own description:—

'This affection may be divided into two stages—the first that of irritability; the second that of torpor. In the former there appears to be a feeble attempt at reaction; in the latter the powers appear to be more prostrate. These two stages resemble in many of their symptoms the first and second stages of [acute] hydrocephalus respectively.

'In the first stage the infant becomes irritable, restless, and feverish; the face flushed, the surface hot, and the pulse frequent; there is an undue sensitiveness of the nerves of feeling, and the little patient starts on being touched or on hearing any sudden noise; there are sighing and moaning during sleep, and screaming; the bowels are flatulent and loose, and the evacuations are mucous and disordered.

'If, through an erroneous notion as to the nature of this affection, nourishment and cordials be not given, or if the diarrhœa continue, either spontaneously or from the administration of medicine, the exhaustion which ensues is apt to lead to a very different train of symptoms. The countenance becomes pale, and the cheeks cool or cold; the eyelids are half-closed, the eyes are unfixed and unattracted by any object placed before them, the pupils unmoved on the approach of light; the breathing, from being quick, becomes irregular and effected by sighs; the voice becomes husky, and there is sometimes a husky, teasing cough; and eventually, if the strength of the little patient continue to decline, there is a crepitus or rattling in the breathing. The evacuations are usually green; the feet are apt to be cold.'

But in such groups of symptoms there is nothing distinctive; and the term 'hydrocephaloid,' which is now seldom heard, might be discarded. Its use can only be justified on the ground that the symptoms met with under such conditions are apt to be occasionally confounded with those which usher in the commencement of acute hydrocephalus. We do not diminish the difficulties — already sufficiently pronounced — besetting the early diagnosis of this latter affection, by endeavouring to group together under one name a set of symptoms which, on different occasions, have no other common bond than that they are apt to occur in delicate children, the tone of whose nervous system has been lowered, and thereby rendered more irritable than natural. We should be really better without such a name, especially now that bleeding and lowering treatment are no longer in vogue for the amelioration of the grave organic affection with which the states in question may occasionally be confounded.

H. Charlton Bastian.

HYDROCEPHALUS, Acute (ὕδωρ, water; and κεφαλή, the head).—A synonym for tubercular meningitis. Tuberculosis *plus* a meningeal inflammation is the generating condition; and acute hydrocephalus is only the occasional, though very frequent, concomitant. *See* Meninges, Cerebral, Diseases of.

HYDROCEPHALUS, Chronic. — Synon.: Water on the Brain; *Hydrops Capitis*; Fr. *Hydrocéphale*; *Hydropisie du Cerveau*; Ger. *Der Wasserkopf*; *Hirnwassersucht.*

Definition.—A gradual accumulation of serous fluid within the lateral and third ventricles of the brain, causing them to become more or less distended, and the head enlarged; occurring principally in infants or very young children; and leading to restlessness, irritability, or convulsions, followed by dulness, drowsiness, motor weakness or actual paralysis, together with failure of mind and of the special senses.

The essential condition in this malady is the intra-ventricular effusion. The cases in which the fluid has been found outside the brain and within the arachnoid sac are, in all probability, merely examples of the disease in which, intra-ventricular effusion having previously been well-marked, the distended corpus callosum, or, it may be, the floor of the third ventricle, has given way, and allowed the fluid to pass beneath the arachnoid. The so-called extra-ventricular form of the disease is therefore, in the majority of cases, merely a secondary and altogether accidental condition.

As a sequence of a large arachnoid hæmorrhage, serous fluid may also be found within the arachnoid cavity; this, however, is a condition which has no real title to be mentioned under the head of chronic hydrocephalus, as some writers have done. And the same remark applies to those accumulations of serous fluid which take place beneath the arachnoid, as a sequence of wasting or atrophy of the cerebral hemispheres, one or both. The collection of fluid in such cases is to be regarded as a simple sequence of the atrophy, and is of itself unproductive of morbid symptoms.

Ætiology.—Two principal groups of causes are appealed to as productive of chronic hydrocephalus. In certain cases the affection is believed to be *idiopathic*, due to an 'essential dropsy,' occasioned by an inflammatory affection of the lining membrane of the ventricles. In other patients, however, this affection is distinctly secondary or *symptomatic*, and then may be caused by one or other of two principal sets of conditions. Thus (1) it is often occasioned, as writers of the last century pointed out, by the pressure of scrofulous or other tumours upon the 'straight sinus,' producing mechanical congestion of the great veins of Galen as well as of their radicles on the walls of the lateral ventricles, and, as a consequence, an increasing dropsical condition of the ventricles themselves. (2) Much more rarely it is said to be produced as a sequence of an attack of acute hydrocephalus. This latter mode of origin is admitted by some authors, and denied by others. It is at least a possible mode of origin, although one which is difficult to be established with certainty. By far the largest percentage of cases probably belong to the first set of the 'symptomatic' category.

The disease is sometimes congenital, and may be so far developed during uterine life as to cause great difficulties in parturition—frequently necessitating the sacrifice of the life of the child. At other times the enlargement of the head begins to show itself soon after birth, or at some period before the end of the first or second year. Or it may reveal itself later still in childhood; much more rarely during adolescence; and more rarely still in adult life.

Congenital 'microcephalism' must not be confounded with hydrocephalus. It is true that in certain small-headed infants, having the cranium malformed and the sutures ossified, an excess of fluid may be found within the head; but then the fluid in these cases is situated outside the atrophied brain, and not within the ventricles. The two conditions are, in fact, totally opposite in nature.

Anatomical Characters.—Three different states, in regard to size of head, have been described as existing in this affection—(1) where the head is smaller than natural; (2) where the head is of natural size; and (3) where the head is more or less considerably enlarged.

Those of the first category ought not to be included at all. They are the cases of 'microcephalism' above referred to. Those of the second category could never be diagnosed with any degree of positiveness during life; and it may, indeed, be questioned whether such cases exist to any large extent, except as more or less transitory stages of instances of the disease pertaining to the third of the above categories.

Even the cases in which the head is distinctly enlarged differ amongst themselves, since in some of them (*a*) both sutures and fontanelles are widely open; while in others (*b*) the sutures, and perhaps the fontanelles, are completely closed. It seems probable that the latter may represent conditions into which some of the former pass, when the disease lapses into a chronic and stationary condition.

Owing to the separation of the cranial bones in young infants, this disease, when it occurs in them, soon becomes associated with an actual enlargement of the head, which increases rapidly. In consequence of the distending pressure from within, caused by the increasing size and fulness of the ventricles, the bones entering into the formation of the vault of the cranium become separated from one another, though the bones of the face remain unaltered. The frontal, parietal, the superior part of the occipital, and a small part of the squamous portion of the temporal bones become expanded and thinner than natural, at the same time that they are separated from one another—especially in the regions of the anterior and posterior fontanelles, and of the sagittal suture.

The cranial bones are often very thin, but occasionally they may be unusually thick throughout—even in young children.

The circumference of the head, though that of a young child, may in hydrocephalus easily reach 24 to 30 inches, or more. The size attained by the head in certain cases has been comparatively enormous; thus, in an altogether exceptional case, recorded by Cruikshank, it is said to have measured, in a child sixteen months old, no less than 52 inches in circumference, and the amount of fluid contained within the cranium was found to weigh as much as twenty-seven pounds.

The fluid is generally slightly albuminous; possesses some saline constituents; and has a specific gravity ranging from 1006 to 1014. Its composition agrees pretty closely with that of dropsical fluids generally.

In the great majority of cases, as already stated, the fluid is contained within the more or less distended lateral and third ventricles of the brain. The upper and lateral parts of the cerebral hemispheres, as well as the corpus callosum, become thinned and distended, so as to resemble a mere bag, the walls of which are represented externally by pale unfolded and much flattened convolutional matter, and internally—next the fluid itself—by the lining membrane of the ventricles. This latter has become much thicker and tougher than natural; it may also be more or less granular on the surface; and often shows an increased number of distended vessels. These appearances are, however, not to be taken as an indication of the inflammatory origin of the malady, as some observers seem to suppose. They may be found, as the writer has seen, well-marked, in cases where the effusion and distension have been the result of a mere mechanical congestion, produced by pressure upon the commencement of the straight sinus, owing to a tumour in the middle lobe of the cerebellum. On the other hand, some years ago the writer examined the head of a hydrocephalic child who died in University College Hospital, in whom the most careful search revealed nothing that could have produced mechanical congestion, and in which there was, moreover, no sign of anything like an inflammatory condition of the walls of the greatly distended lateral ventricles. To fall back upon the hypothesis of an 'essential dropsy' was felt to be far from satisfactory. Such a phrase cannot indeed be regarded as conveying any real explanation of the condition in question.

The shape of the ventricles and of the compressed ganglia about the base is, of course, greatly altered. The foramen of Munro may be half an inch or more in diameter. The optic and olfactory tracts and lobes are also often much altered by pressure.

The brain-substance may be even tougher than natural, because the long-continued mechanical congestion, which exists in so many cases, favours the overgrowth of the neuroglia; and, indeed, it would appear probable that in some instances the overgrowth of this mere connective substance is well-marked. For, notwithstanding all the pressure upon and distension of the brain-substance, this rarely shows signs of atrophy. It is rather the reverse. The mere brain alone of a hydrocephalic child, after the fluid has been evacuated, commonly weighs more than the brain of a healthy child of the same age. Thus, in an instance that came under the writer's notice, the brain of a child five years of age weighed rather more than 52 oz.

In those cases in which during life the fluid has escaped from the ventricles through a rupture in the corpus callosum, the brain has been found more or less flattened and collapsed in the lower part of the enlarged cranium, whilst the escaped fluid occupies the arachnoid cavity above it.

Symptoms.—Chronic hydrocephalus begins to manifest itself in various ways, and also, as above stated, at various ages. The great bulk of the cases are either congenital, or commence before the fifth month. But, in certain rare instances, the head may begin to enlarge long after the union of the sutures, in early adult life, or even beyond middle age.

As to modes of commencement, at least four, pretty distinct from one another, may be encountered. (1) The disease may be ushered in by a period of fretfulness and irritability, with or without the occurrence of convulsions and strabismus, before any enlargement of the head is detected. Or (2) slow enlargement of the head may be noticed as the first event. In some cases, this enlargement not only sets in, but may continue for months, till notable increase in size has taken place, and yet the child may exhibit no morbid symptom whatever. The writer has seen a well-marked instance of this in a child whose head had been enlarging for eighteen months (the process beginning when it was a year old), and in whom, though the head was twenty-four inches in circumference, no other morbid signs or symptoms presented themselves. (3) Chronic hydrocephalus may supervene in a child after a fall, through the intermediation of cerebellar disease. The writer had under his care a little girl four years old, who, after falling from a table and striking the occiput severely, suffered for from twelve to eighteen months from symptoms indicative of cerebellar disease, after which the head began to enlarge, and hydrocephalus became the apparently dominant condition. Complete blindness ensued, then convulsions set in, and in the midst of one of these the patient died. A tumour of the middle lobe of the cerebellum was found, *plus* all the signs of a well-marked hydrocephalus. (4) The disease may occur as a sequence of an attack resembling acute hydrocephalus (tubercular meningitis); that is to say, a child appears to suffer for a time from what is regarded as tubercular meningitis; the symptoms then undergo some mitigation; they become more or less chronic; and ultimately the head begins to enlarge, as it does in chronic hydrocephalus. There is some doubt about the real nature of the starting-point in this mode of origin. The initial symptoms may not in reality have been those of tubercular meningitis. The chronic disease and its symptoms may occasionally be initiated in an acute manner.

It may be easily imagined that the subsequent course of the symptoms in persons suffering from chronic hydrocephalus, beginning in these various ways, may also be subject to great variations.

As the head enlarges, or as the pressure within increases, sensations of weight or pain may be experienced. The child may show increased fretfulness and irritability; or its manner may become more dull and heavy than natural. At other times there is no noticeable change in these respects.

In the 'symptomatic' forms associated with tumours, there is apt to be vomiting of a very obstinate and paroxysmal character, together with continuous pain, marked by exacerbations. Convulsions, either unilateral or general, may also occur, as well as paralysis of one or other of the ocular muscles. In such cases, too, in comparatively early stages, ophthalmoscopic examination will frequently reveal optic neuritis, which has a tendency to go on to white atrophy, with the production of more or less complete blindness.

In later stages of the disease mental action becomes increasingly impaired; there is loss of memory, dulness, and a great tendency to sleep during the day. There may be marked weakness or actual paralysis of limbs. Children affected to this extent often keep to the recumbent position, having at last no power of sitting up, or even of raising their head from the pillow. Where the enlargement becomes extreme the weight of the head is so great that it cannot be maintained in the upright position. It has to be supported by the hand or some artificial prop; or else the child does not attempt to rise from the recumbent position. A sense of fluctuation is often recognisable. The forehead becomes prominent and overhanging, while the eyeballs are depressed; and as the face remains unaltered or even becomes emaciated, it seems altogether unnaturally small, and thus contributes to produce a most characteristic appearance ('facies hydrocephalica'), which is often intensified by the old-looking, and more or less blank, expressionless aspect of the face. The appetite sometimes remains good; at other times it becomes much impaired, and a gradual emaciation ensues. Blindness, more rarely deafness, loss of smell, and impairment of other senses tend gradually to reveal themselves after a time.

Complications.—In all cases where the hydrocephalus is itself symptomatic of some primary intracranial disease, interfering with the proper return of blood from the ventricles and central portions of the brain, the symptoms resulting from this latter state of things are necessarily complicated with others immediately produced by the original morbid condition. Hence the very great variations encountered in the grouping of symptoms in different cases.

Diagnosis.—Where the head becomes distinctly enlarged, with widely separated sutures and open fontanelles, there can be scarcely any room for doubt about the diagnosis. But before the head is distinctly enlarged, the diagnosis of chronic hydrocephalus with any degree of certainty is impossible. In many cases also where the head is only slightly enlarged, and the sutures are not opened, it may be very difficult, for a time, to pronounce an opinion as to whether or not an infant or young child is hydrocephalic. Natural variations in the size of the head are considerable; and it may also be enlarged from rickets, or from that very rare condition known as 'hypertrophy of the brain.' Even great thickenings of the bones of the head have occasionally given rise to uncertainties in regard to diagnosis. But in all these cases, in order to enable the practitioner to arrive at a trustworthy opinion, the particular form of the head has to be considered, together with the sum-total of the various symptoms which may have preceded or accompanied its increase.

Whether we have to do with an instance of 'idiopathic' or of 'symptomatic' hydrocephalus in any particular case often cannot be settled; but in others it can be decided by the existence of symptoms distinctly pointing to the presence of an intracranial new-growth.

Course and Terminations.—Hydrocephalus often proves fatal in the course of a few months; or it may be less rapid, entailing death only after a year or two. Its progress is variable, however. Remissions and stationary conditions are apt to occur, with occasionally distinct exacerbations of all the symptoms.

Occasionally one of these stationary conditions becomes prolonged, and the individual may live for years. Some hydrocephalic subjects have subsequently lived on to the age of twenty, thirty, or even forty years. In a few exceptional cases a cure seems to have been effected, either naturally or under the influence of remedial agencies.

Death may take place in convulsions; from slow exhaustion with emaciation; or from intercurrent pneumonia or some other acute disease.

Treatment.—Very little, unfortunately, can be done, in the majority of cases, to produce decided or lasting improvement. This is especially so in those instances—only too numerous—in which the hydrocephalus is due to some scrofulous or other tumour interfering with the return of blood from the ventricles.

Blistering the scalp, with mercurial inunctions, formerly much lauded, may do a great deal more harm than good; and the same may be said in reference to pressure of the enlarged head by strapping or bandages. This latter is a barbarously coarse method of treatment, which has happily fallen into disuse. Blistering may do good in some cases, but it should be cautiously employed.

The general health of the child must be maintained as much as possible, by the aid, if necessary, of tonics and cod-liver oil. Purgation and diuretics may also be had recourse to. Iodide of potassium may be given internally in gradually increasing doses, as even young children bear this remedy well. Bromide of potassium will also help, perhaps, to mitigate vomiting and convulsions, when these are urgent symptoms.

It may be worth while in suitable cases to try the effect of greatly diminishing the amount of fluids taken, so as to reduce the fulness of the vascular system. The writer has had reason to believe that this method is well worthy of being tried, where other means have failed, and where there is any chance of being able to carry it out.

Puncture of the head has been much lauded, and practised by many, but with an amount of failure and fatality that has caused the method to have almost fallen into disuse. If in any given case we could be reasonably certain that the hydrocephalus belonged to the 'idiopathic' variety (if there really are such cases), the method might be had recourse to with much more chance of success than if it were occasioned by some mechanical pressure, which persists, and prevents the return of blood from the central parts of the brain. Puncture of the head can scarcely be compared with puncture of the chest, because (even apart from the greater risks attaching to the former operation) a puncture of the chest in a case of pleurisy has a fair chance of being actually curative, while puncture of the head in hydrocephalus, in the majority of cases and for the reason above indicated, could only be palliative. Still the cases of this disease are so grave that where the sutures are opened, where the patient's condition is rapidly getting worse, and death seems otherwise inevitable, the question of performing the operation, at least once, ought to be entertained as a possible means of affording relief.

H. Charlton Bastian.

HYDROMETRA (ὕδωρ, water; and μήτρα, the womb).—Dropsy of the womb. *See* Womb, Diseases of.

HYDRONEPHROSIS (ὕδωρ, water; and νεφρός, the kidney).—Synon.: Dropsy of the Kidney; Fr. *Hydronéphrose*; Ger. *Hydronephrose*.

Definition.—A chronic disease of the kidney, caused by obstruction of the ureter; which leads to dilatation of the pelvis, and commonly of the ureter, with more or less extensive atrophy of the substance of the organ; usually affecting one kidney, sometimes both; characterised clinically by the presence of a soft fluctuating tumour in the renal region, but most distinctively by sudden discharge of urine with collapse of the tumour; and resulting, if not relieved, in complete destruction of the kidney.

Ætiology.—Among the most common causes of hydronephrosis are obstruction of the ureter at its lowest part, in consequence of pressure by new formations, such as carcinoma of the uterus or tumour of the ovary in females, and the impaction of calculi of various kinds. More rarely it is induced by new formations in the bladder; stricture of the urethra; the pressure of the pregnant, prolapsed, or retroflexed uterus. Exceptionally it is met with without apparent cause; in such cases it is to be referred to some contraction, due to inflammation or other cause, which has disappeared. The condition is also sometimes congenital, being due to malformations, such as impermeable ureter, or valve-like obstruction to the passage of the urine downwards. From whatever cause the obstruction springs, accumulation of urine takes place behind it, leading to gradual distension of the organ. *See* URETERS, Diseases of.

ANATOMICAL CHARACTERS.—In the earlier stage of hydronephrosis there is simple dilatation of the pelvis of the kidney. As the disease advances, the dilatation increases, the organ becomes more and more distended, and the ureter often becomes so dilated or elongated as to present the appearance of a bluish-white tube, as large as or even larger than the inferior vena cava. Coincidently with this distension and pressure the substance of the kidney atrophies. At first the apices of the cones become flattened and wasted, but gradually the renal substance becomes more involved, until at length, in old-standing cases, scarcely any trace of it remains, and the kidney is represented by a large lobulated bag, the fibrous walls of which are distended by clear fluid. Commonly one kidney only is affected, especially when extreme dilatation exists, but in some instances both kidneys are involved. There is a case on record where the whole abdominal cavity was occupied by an enormous sac, containing sixty pounds of fluid.

SYMPTOMS.—In the slighter cases of hydronephrosis there are no symptoms of such a kind as to attract attention. This condition is often an unimportant complication of other serious diseases. In the more severe cases there are no constitutional symptoms, but the local changes are well-marked. There is a tumour situated in the lumbar region, extending upwards, downwards into adjacent regions, or forwards towards the anterior abdominal wall. The colon is usually in front of the tumour, and always displaced and compressed, so that constipation frequently coexists with hydronephrosis. The mass is often lobulated, always undulating in character; and frequently fluctuation may be detected. The most conclusive evidence of the condition is afforded by the discharge of a large quantity of urine, generally of low specific gravity, and often containing mucus, coincidently with the disappearance or diminution of the tumour. It sometimes happens that the obstruction is permanently removed, and dilatation alone remains as evidence of the old obstruction. Hydronephrosis, when double, sooner or later proves fatal by suppression of urine or uræmia. When only existing on one side, it has proved fatal by pressure upon neighbouring parts; by the supervention of impaction of a stone in the kidney of the opposite side; or from other causes.[1]

DIAGNOSIS.—The distinction of hydronephrosis from ascites may be sometimes difficult when the disease affects both sides. The diagnosis is partly to be made by observing the effects of change of posture, hydronephrosis being much less influenced thereby than ascites. The history and mode of origin of the affection also afford indications. From hydatids of the kidney it is sometimes impossible to discriminate hydronephrosis, but the history of the case and the characters of the urine often afford a clue. If there be tumour on both sides, it is extremely unlikely to be hydatid. From ovarian tumour the diagnosis is to be made by the history of the case, the position ot the mass, and its relations to the colon; and by vaginal and rectal examination. From perinephric abscess hydronephrosis is distinguished by its being less hard, and by the absence of pain and fever.

PROGNOSIS.—The prognosis is always serious; but if one of the kidneys be sound, it becomes enlarged, and does double work; and so long as this condition continues, the patient may suffer little inconvenience.

TREATMENT.—Careful manipulation of the tumour is often useful in extreme conditions. Tapping with the aspirator may be employed, and the further aid of the surgeon may be required.

T. GRAINGER STEWART.

HYDROPATHY (ὕδωρ, water; and πάθος, a disease).—A synonym for hydrotherapeutics. *See* HYDROTHERAPEUTICS.

HYDROPERICARDIUM (ὕδωρ, water; περί, about; and καρδία, the heart).—An accumulation of serum in the pericardium, either dropsical or inflammatory. *See* PERICARDIUM, Diseases of.

HYDROPHOBIA (ὕδωρ, water; and φόβος, fear).—SYNON.: Rabies; Dog-madness; Fr. *Lyssa*; *la Rage*; Ger. *Hundswuth*; *Wasserscheu*.

DEFINITION.—An acute disease, produced by the inoculation of a specific animal poison; manifesting itself by symptoms due to disturbance of the central nervous system; and almost invariably proving fatal. The name 'hydrophobia' is really that of a single symptom, which, though very common, is not invariable.

ÆTIOLOGY.—Never spontaneous in man, the disease is always due to inoculation with the poison from a rabid animal, almost invariably with the saliva, and commonly by a bite. In about nine-tenths of the cases, the malady is contracted from dogs; in most of the remainder from cats; in very few cases from foxes or wolves, but a larger proportion is due to wolf-bites in countries where these animals are numerous. It has also been acquired through a wound received during the dissection of a rabid animal. Inoculation with the blood of a rabid animal will probably (but not certainly) produce the disease. The poison is not known to be present in any other secretion than the saliva, but it is abundant, after death, in the central nervous system. Commencing decomposition is said to destroy its activity, but it sometimes resists this for many days. The dried saliva retains its virulence for some days, but in the dried nerve-centres the virus gradually loses its activity, and becomes inert in about ten days.

---

[1] In one case, which occurred some years ago, the cyst, in collapsing after being tapped, carried with it the sigmoid flexure, which being thus turned on itself caused fatal obstruction.—EDITOR.

Inoculation by a bite takes place more certainly if this is on an uncovered part of the body, as on the hands and face, than when inflicted through the clothes, by which the teeth may be cleansed. But it may occur without an actual bite, as by a lick upon an abrasion. It has followed the scratch of a cat, probably by the animal's saliva being thus inoculated. A healthy dog has communicated the disease by a bite given immediately after it had been fighting with a rabid animal, the saliva of which, no doubt, was hanging about its jaws. The disease has resulted from the teeth being used to loosen a knot upon a rope with which a rabid dog had been tied.

It has been asserted that the disease may arise from the bite of a healthy dog, but this is most improbable. Cases are on record, however, in which the disease has followed the bite of a dog, which did not at the time, or for several weeks afterwards, present the recognised symptoms of the disorder. It is probable that, in such cases, rabies has occurred as a mild and insignificant malady, since it is certain that a dog may recover even after communicating fatal rabies.

When no preventive measures are adopted, at least half, perhaps two-thirds, of persons bitten escape. The immunity may be due partly to the bites being inflicted through clothes, but probably a fallacy underlies the estimate, owing to the inclusion of many bites from dogs not really rabid. A certain diagnosis can only be made by inoculation, but the preventive treatment of Pasteur has, fortunately, made it now impossible to obtain statistics on the point.

More males than females suffer, the proportion being three to one. The largest number of cases occur in the middle period of life, doubtless from greater exposure to the cause. Children, however, are prone to suffer, being often badly bitten on the face. Most cases are contracted from straying dogs, or from pet dogs that have been bitten in some street fight.

The *period of incubation* is longer than that of any other acute specific disease, and is singularly variable. It is rarely less than a month, the shortest on record having been about twelve days. The average period is six or seven weeks. In about half the cases it is between one and three months. In some cases it is longer, reaching six, nine, or twelve months. Cases have been recorded in which two, three, five, and even ten years intervened. Most authorities believe that such cases were either not true hydrophobia, or were due to a second unknown infection. Although it is as hard to explain an incubation period of one year as of five years, it is certain that the lick of a strange dog on a scratched hand is more likely to be forgotten than remembered, and an unnoted later infection is, on the whole, the most probable explanation of these cases.

ANATOMICAL CHARACTERS.—General fluidity of the blood, such as is met with after death from acute septic diseases; redness of the throat and pharynx, and occasionally of the salivary glands; together with, in some cases, evidence of congestion of the brain and spinal cord, constitute the chief morbid appearances visible to the naked eye. The microscope has shown that there is evidence of inflammation (congestion and leucocytal infiltration) in the salivary glands (Coats); and that minute changes in the nerve-centres are almost constantly to be found (Clifford Allbutt, Hammond, Benedikt, Coats, and the writer). Of nine cases examined by the writer, the microscopic changes in seven were distinct, and in character and position so far characteristic, that, given the fact of an *acute* disease, a *post-mortem* diagnosis might, in this proportion of cases, be made with certainty by the microscope. The essential change consists in the accumulation of leucocytes around the vessels, and their infiltration into the adjacent tissue; this change having a special distribution, being either confined to, or most intense in, the region of the medulla which is contiguous to the lower part of the fourth ventricle, that is, the neighbourhood of the respiratory centre. Here we have also the centre for deglutition. The change is most intense in the hypoglossal, glosso-pharyngeal, and vagal nuclei and their neighbourhood. There is little or no change in the upper part of the medulla, corpora quadrigemina, cerebellum, or basal ganglia. In the convolutions a similar but slighter alteration is present in some cases. It is, however, often very marked in the spinal cord. In the most affected regions, traces of *ante-mortem* clots and even of inflammation of the walls of the minute vessels may be found in some cases. Perivascular areas of disintegration are common; but such frequently occur apart from hydrophobia or any other disease. Minute extravasations are common, partly mechanical. The only change in the nerve-elements themselves consists in a granular degeneration of the ganglion-cells of the regions chiefly diseased. In the dog the changes are quite similar in characters and distribution.

SYMPTOMS.—During the period of incubation of hydrophobia there are commonly no symptoms. Vesicles under the tongue were formerly described, but their occurrence has not been confirmed. Occasionally pain and discomfort have been felt in the seat of the wound, explicable, in part, by the attention directed to it, but sometimes too pronounced to be thus explained, especially during the week or two preceding the onset. Mental depression has been noted, also probably due to anxiety regarding the possible consequence of the bite.

The onset of the acute symptoms is commonly attended by no local disturbance, although sometimes by pain, rarely by actual inflammation, in the wound. The first evidence of the impending disorder is usually malaise, mental depression, disturbed sleep, and some discomfort about the throat, with a difficulty in swallowing, especially liquids. The attempt occasions some spasm in the throat, which soon, if not at first, involves the muscles of respiration, causing a short, quick inspiration, a 'catch in the breath,' resembling that due to an affusion of cold water. In a few hours this increases to a strong inspiratory effort, in which the extraordinary muscles of respiration take more part than the diaphragm; the shoulders are raised, and the angles of the mouth are drawn outwards. The saliva, which is abundant and viscid, cannot be swallowed. It hangs about the mouth, and the patient is annoyed by his efforts to get rid of it. As the intensity of the spasm increases, so does the readiness with which it is excited. The mere contact of water with the lips, or cutaneous impressions, as a draught of air, will bring on a paroxysm, owing to the intense reflex excitability. The distress thus occasioned leads to a mental state, which is due to disturbance of the cortex, but increases the readiness with which the spasm is produced. The intense excitability of the sensory centres may be such that mere sight of water, or the sound of dropping water, will cause the spasm, and even analogous visual impressions, as a sudden light or the reflection from a looking-glass. Thus the respiratory spasm excited by swallowing liquids, which is, as it were, the keynote of the disease, extends on the one hand to widely spread muscular spasm, and on the other to mental disturbance. In each of these directions the symptoms develop. The early reflex excess involves the spinal cord, the knee-jerk is increased, and reflex action in the legs may be great. While this over-action increases, the spasm, from being limited to the muscles of respiration, may become general and convulsive in character, though still excited by the same causes. The mental distress passes into disturbance, in which the balance of reason is lost, continuously or during the paroxysms. In the frenzy, the horror of the distress is transferred to the attendants by whom any discomfort may have been occasioned, and during the paroxysms the patient may attempt to bite them, and even others. Consciousness may so far remain that in the intervals he may beg those whom he regards to keep away. The saliva is ejected with force, and the patient hawks it up with a noise 'like a dog.' The sight of a dog has been known greatly to intensify the disturbance; and this, strangely enough, in cases in which the sufferer had no suspicion of the nature of his affection. The delirium may, in some cases, be continuous and violent. As the mental disturbance increases, the respiratory spasm and convulsion may lessen, or the latter may persist to the end.

Vomiting is common, and is often an early symptom, a greenish-brown liquid being ejected. Priapism or nymphomania occasionally occurs. The temperature is usually raised two or three degrees. Albumen is often present in the urine; and sometimes sugar is found.

Duration and Terminations.—The duration of hydrophobia is usually from one to four days; sometimes it lasts six, eight, or ten days. In the rare cases which have recovered, the duration of the acute affection has been from four to ten days, although slight spasmodic symptoms have lasted for a longer time, as does the spasm of whooping-cough.

The common cause of death is exhaustion due to the attacks of fury and convulsion, often aided by manifest cardiac failure, which may occur early, and be out of proportion to the general asthenia. Sometimes the patient has died asphyxiated in a paroxysm of respiratory spasm; partly, perhaps, from spasm of the glottis.

Varieties.—The relative degree of the above-described symptoms varies in different cases. The mental disturbance, or the general muscular spasm, may, respectively, predominate over the respiratory throat-spasm, even in the early stages, and may impress a special character on the attack, so that it resembles in the one case a primary mental affection, in the other a general convulsive affection, as tetanus.

Pathology.—We cannot doubt that the virus of hydrophobia is a micro-organism, although this has not yet been clearly detected. It is supposed that the organisms or their germs, frequently at least, remain in the tissues near the wound, and only become dislodged at a later period, to reach the nerve-centres and there develop (Pasteur). The symptoms indicate a primary influence on the nerve-centres, especially on the respiratory region of the medulla, spreading more widely in its ultimate action, both in the medulla and to the brain and cord. The vascular changes, from their variability and occasional absence, are probably secondary effects of the disturbed action of the nerve-structures, produced by the poison carried by the blood. The virus has been thought to ascend by the nerves, but this is not likely, although germs may simultaneously enter the peripheral nerves and develop there, since the virus has been found to be abundant in them (Dowdeswell).

The first effect of the poison is probably to lessen the 'resistance' of the medullary centres. Their action becomes spasmodic, and is excited with undue readiness. The excessive action of the medulla and spinal cord finds its counterpart in the cortex and the delirium which results. At a later stage this gives place to depressed activity, which may end in paralysis and coma, when general, but is sometimes unequal in its distribution. The secondary vascular changes may have their own effects. They are, as in other functional diseases, somewhat random in distribution within the affected area. By the infiltration of leucocytes, the tissue may be broken up, and what are practically minute points of suppuration may result. If the part damaged is important, grave consequences may ensue. The nucleus of the pneumogastric is often so damaged, and from this, or the late depression, we can understand the occurrence of cardiac failure. The changes in the convolutions and the spinal cord are probably proportioned to the mental or tetanoid (and paralytic) symptoms respectively. The mental excitement no doubt acts upon and increases the irritability of the medulla (Putnam). Conversely, the disturbance of the latter may help to determine the character of the mental disturbance due to the poison of hydrophobia.

Diagnosis.—The symptom of greatest diagnostic value is the respiratory spasm excited by attempts to swallow, increasing until it resembles a convulsive action, and accompanied after a time by mental disturbance. The diagnosis is generally aided by the history of a suspicious bite, but it must be remembered that such a history sometimes misleads, especially when the mind of the patient has dwelt much on the possible consequences, and he has made himself acquainted with the symptoms of the disease. In certain diseases of the throat and chest, especially œsophagitis and pericarditis, a reflex throat-spasm may occur, but in such cases there are commonly pain and other obtrusive signs of the local affection. When the mental disturbance occurs early, the affection may be confounded with acute mania: the association with slight respiratory spasm is still the most important diagnostic indication. In cases (if such occur) in which this symptom is absent, the diagnosis is a matter of great difficulty, and can only be made by the history of the antecedent bite, by the rapid course of the disease, and by its association with other convulsive phenomena and with salivation. From tetanus, hydrophobia is distinguished by the late period after the bite at which the symptoms develop; by the absence of trismus and of continuous spasm; and by the presence of paroxysmal respiratory spasm, of aversion to liquids, and of mental disturbance. Too much weight must not be given to the general character of the convulsive symptoms, if other signs of the disease are present, since there is probably a tetanoid form of hydrophobia; but in this the spasm is excited by attempts at deglutition, and there is no trismus. Organic brain-diseases accompanied by delirium and convulsions, occurring after a bite, have been mistaken for hydrophobia, as in one case in which the nature of the disease was only discovered when, after exhumation, meningeal hæmorrhage was found. Here also the respiratory spasm was absent.

Mere mental excitement, directed to the symptoms of the disease, may determine dysphagia simulating that of the genuine disease—'spurious hydrophobia' as it has been termed, often accompanied by delirious excitement. The spasm, however, is not of the respiratory character of true hydrophobia. Recovery commonly ensues on the mind being tranquillised, or by the application of some remedy in which the patient has confidence. It must be remembered that in some cases of genuine hydrophobia the influence of the patient's mental state has been very clearly traceable even in the early symptoms, and it is probable that many true cases have been regarded as spurious, and even published as such. It is doubtful whether death has ever resulted except from the genuine disease.

Prognosis.—Hydrophobia is practically fatal, but not certainly so. Recovery has certainly occurred in the dog and probably in man. Every patient should unquestionably receive the 'benefit of the doubt.' Cases differ in the intensity and rapidity of their course; and the less rapidly the symptoms are evolved, the greater is the hope, slight though it still is, that an exception to the common fatality may be obtained. The prognosis is better the longer the spasm remains limited; it is worse if there are general convulsions, mental disturbance, and signs of exhaustion or of disproportionate heart-failure.

Treatment.—Adequate measures against the spread of rabies would undoubtedly lessen, perhaps entirely prevent, the occurrence of hydrophobia in man; but the discussion of these is beyond the scope of this article (*see* Rabies). When a person has been bitten by a suspicious animal, the circulation in the part should, if possible, be at once arrested by a tight ligature above the place; the wound should be washed; and then it should be allowed to bleed freely. It may probably be sucked with impunity if the mouth is rinsed with water or, better still, with vinegar and water, after each act, especially if there are no abrasions in the mucous membrane. The act has been supposed to be dangerous; but all experience is opposed to this. Poisons have to remain for some minutes in contact with a mucous membrane before they are absorbed, and during the act of sucking there is a flow from the mucous membrane into the mouth, which must be opposed to absorption. The wound should be cauterised as soon as possible, and before circulation through the part is again permitted. Of chemical caustics, nitrate of silver, freely applied at once, is probably effectual. If any time have elapsed, nitric acid or liquid carbolic acid is preferable. The actual cautery, applied deeply and freely, is an efficient and ready means. If practicable, free excision of the bitten part is wise, and should not be neglected, even though the cautery has before been used, especially if there is any doubt as to the thoroughness of the application. Without arrest of the circulation, cauterisation after ten minutes has often failed.

Next in time, but first in importance, is the prophylactic treatment of Pasteur, employed as soon as possible after the bite. The dried spinal cord of a rabbit contains less and less of the virus, up to the tenth day of drying, when it fails to produce the disease. If an emulsion of such a cord is first injected, then, on successive days, that of cords dried for a shorter time may be employed, until a strength of cord-virus is injected that would otherwise cause the disease. Not only does this fail to do so, but it prevents the occurrence of rabies from the virus inoculated by the preceding bite, and thus confers immunity even against the past inoculation. It is believed that the organisms of the virus produce a material, probably chemical, destructive to them, incompatible with their development, and that this is not destroyed by the drying in the same degree as the virus. Being injected in larger and larger quantities from cords dried for a shorter time, it effectually protects both from the virus injected with it and from that which was already in the system. Facts show that this result, though not absolutely certain, generally follows, and that the mortality from bites by certainly rabid animals is reduced to about 1 per cent. The most careful estimate shows that, during the last five years Pasteur has thus saved at least 1,000 lives. (For a detailed account of the treatment, *see* Ruffer, *Brit. Med. Journ.* 1889.)

The methods adopted for the treatment of the developed disease have been numerous, but, for the most part, quite ineffectual. All so-called 'specifics' have been proved to be useless. An attempt has been made to neutralise the poison by administering large doses of mercury, and to eliminate it by diaphoresis. The two have been combined in the mercurial vapour-bath. Two or three cases are on record in which mercury has appeared successful; many in which it has been powerless. Of late it has been but little tried; nevertheless, there are facts which suggest that the apparent influence of mercury has been real, and that in it we have probably a more promising means of counteracting the virus than in any other agent. The vapour-bath treatment has been abundantly proved to be entirely useless, although its supposed value is, from time to time, reaffirmed by lay advocates whose energy is proportioned to their ignorance.

Other agents employed have been designed to counteract, not the virus, but its consequences, and so to prevent or postpone death, possibly until the malady has run its course. One of these is curara, first recommended half a century ago by an Englishman (Sewell); it was tried in small doses and failed. Niemeyer suggested larger doses, and in a case by Offenburg it was apparently successful; and since then another case, in America, has recovered under its use. In many cases it has failed—in all cases in this country up to the present time. It is recommended that it should be used in injections of from $\frac{1}{16}$ to $\frac{1}{3}$ of a grain, repeated every quarter or half an hour, until the severity of the paroxysms is lessened. This point may not, however, be reached until general muscular paralysis is imminent or produced, and then artificial respiration may be necessary until the effect has passed away. As often as this is the case, and the spasms recur, another injection must be given. In hydrophobia there is remarkable tolerance of the drug, poisonous doses (one grain repeated) of active curara having in one case been without any effect (Curtis). This is, perhaps, a hopeful fact, as it indicates that curara has an action to which the changes in the central nervous system are opposed.

Ordinary sedatives have been the remedies commonly employed, and of these the best are chloral and morphine. One case (probably genuine), in which morphine and Calabar bean were used, recovered (Nicholls); and one in which chloral was employed lived for ten days (Sansom). The effect of the two on the respiratory centre in animals suggests their joint use. The morphine should be given by hypodermic, the chloral by rectal injection. Chloroform is useful in moderating the paroxysms, but appears somewhat inferior to chloral. Other sedatives—Indian hemp, &c.—have appeared of inferior value.

Cold affusions to the cervical spine and head were used in India in two cases which recovered, the throat and spine being blistered with nitrate of silver, and chloroform administered. Ice to the spine has been tried without effect. Tracheotomy was recommended by Marshall Hall in one case. Death from laryngeal spasm is, however, too rare to justify the measure.

In all cases tranquillity is of the greatest importance. Every excitant of spasm should be avoided; the patient being kept in a dim still room, and friends as much as possible excluded. Next in importance is nourishment, which should be given by the rectum, if spasm is excited by the attempt to swallow. Restraint, which may be necessary, should be as little as possible, but it should be effectual.

The saliva of persons suffering from hydrophobia has been proved to be capable of communicating the disease to animals. Hence the attendants should be cautioned to have no uncovered abrasion on the hands, and to wash from the eyes or face any saliva which may have been spit on them; and if they are bitten by the patient, the wound should be treated as if it had been inflicted by a rabid animal. These precautions remove all danger; and any anxiety the subjects may feel may be relieved by the assurance that, of the thousands of persons who have attended on patients with hydrophobia, no authentic instance has ever been recorded in which the disease was contracted, either by attendance during life, or inspection after death.

W. R. GOWERS.

HYDROPS (ὕδωρ, water).—A synonym for dropsy. *See* DROPSY.

HYDRORHACHIS (ὕδωρ, water; and ῥάχις, the spine).—A collection of fluid in the spinal canal. The term is commonly used as a synonym for spina bifida. *See* SPINA BIFIDA.

HYDROTHERAPEUTICS (ὕδωρ, water; and θεραπεύω, I treat).—SYNON.: Water-cure; Hydropathy; Fr. *Hydrothérapeutique*; Ger. *Wasserheilkunde.*

It would be out of place were we to enter here into a description of the sources and the composition of the numerous varieties of water used for hygienic and dietetic purposes; but we may refer to Dr. Parkes' instructive *Manual of Practical Hygiene.* We intend to divide this article into (1) a short sketch of the history of the water-cure or hydrotherapeutics; (2) notes on the internal use of water, and on the more common hydrotherapeutic procedures; and (3) a consideration of the morbid conditions suitable for hydrotherapeutic treatment.

History of the Water-cure.—Although the old Greek and Roman physicians occasionally employed water internally and externally in the treatment of disease, the systematic water-treatment seems to have gained ground for the first time in the fifteenth and in the beginning of the sixteenth century in Italy and France, and again after a period of oblivion in the seventeenth century, especially in England (Floyer, T. Smith), and in the beginning of the eighteenth century in Germany (F. Hoffmann). The next important scientific application we owe to J. G. and J. S. Hahn, who, towards the middle of the eighteenth century, treated febrile diseases with cold sponging, and were so convinced of the beneficial result, that one of them when attacked with typhoid fever subjected himself to this treatment. It fell, however, again into neglect, until towards the latter part of the eighteenth century, when Wm. Wright, James Currie, W. Jackson, and others resuscitated the cold-water treatment in fevers, and strengthened their reasoning by thermometric observations. In spite of the results obtained, not only in England but also in Germany, amongst others by Reuss, Frohlich, Brandis, and Horn, the method was again falling into disuse when, soon after 1820, a small farmer, Vincent Priessnitz, of Graefenberg, in Silesia, began to treat every kind of ailment, chronic as well as acute, with various hydrotherapeutic procedures, and added to the external applications the abundant internal use of water, combined with active exercise, and a very simple diet; prohibiting at the same time all alcoholic beverages, and also tea and coffee. Priessnitz gradually made considerable changes in his method of treatment. For the original packing during several hours in dry woollen blankets covered with feather-beds, and followed by cold affusions, he substituted packing in wet linen sheets during several hours, followed by a full bath or a douche; and at a still later period he frequently employed cold wet packing of only fifteen or twenty minutes' duration, repeated several times on the same day; he introduced also the method of rubbing the whole body with a cold wet or dripping sheet instead of the full bath, and made extensive use of partial baths, as hip or sitz baths, baths for the hands, the arms, the feet, wet abdominal belts, and wet compresses over different parts of the body. Priessnitz seemed to search for a universal method applicable to all cases. One of the guiding ideas was that disease of the most different nature was caused by an acrid humour in the blood, and that the skin was the organ through which this humour was to be removed.

Though the success of such treatment, combined with active exercise in a healthy mountainous country, and simple diet, was considerable in many cases, the indiscriminate, too energetic, and protracted use often led to unfavourable results, and the system was beginning to be regarded as a species of quackery, when, about fifty-five years ago, some establishments were placed under the superintendence of regularly educated physicians, who studied the physiological effects of the different forms of bathing, and modified them with regard to duration, temperature, &c., according to the requirements of individual cases, combining pharmaceutical remedies with hydrotherapeutic procedures when required. Thus a more or less modified water-cure has now become a branch of rational medicine, at least in France and Germany; and a new impulse has been given to it during the last thirty years, by the employment of various forms of baths in the treatment of fevers. In this country there is as yet very little systematised relation between the special hydrotherapeutic and the general medical treatment; and the experience gained at hydrotherapeutic establishments is not communicated and discussed in our medical societies, and scarcely ever in the general medical journals. This is much to be regretted, for there can be no doubt that hydrotherapeutic measures might be more widely introduced with great advantage into our hospitals, as well as into our private practice; but this is not likely to be the case so long as the medical profession has not fuller opportunities for studying the effects of water-treatment. The fault may lie to some degree in the nature of most of the establishments for the water-cure; but this might be remedied if more establishments were to be erected under the guidance of superior members of the profession—establishments where the usual medical, dietetic, and hygienic treatment, as well as massage and gymnastics, would in suitable cases go hand in hand with hydrotherapeutic management adapted to the individuality of each case.

Internal Therapeutic Use of Water, and the more Common External Hydrotherapeutic Procedures.—The dietetic necessity of water is well known; life cannot exist without it; all our tissues contain an indispensable proportion of water; we constantly lose a large amount by respiration, and by all excretions; all the internal functions of tissue-change are dependent on a certain quantity of water. This want is supplied by the solid and fluid food which we take, water included; while temporary excess of supply leads to increased discharge by the excretions, and temporary deficiency to a diminution of the water of the excretions. An increased ingestion of water further leads, for a time at least, to an increased removal of the products of retrogressive tissue-change; the tissues and the blood itself are, so to speak, washed out by it; and, as the consequence of the increased removal of the used-up material, the body is enabled to take in a larger amount of new substance, and hence we observe not rarely increase of weight as the effect of plentiful water-drinking, if not carried to excess as regards quantity and time; the secretions of the urine, bile, saliva, and pancreatic juice appear to be increased by the abundant internal use of water, as well as the perspiration; though the latter to some degree requires the concomitant influence of high external temperature or bodily exercise.

Water has also an important share in all internal courses of mineral waters. Used by itself, it can exercise some good influence in cases of gout and gravel, in hæmorrhoidal complaints, imperfect secretion of bile, and constipation from sluggish peristaltic action. As, however, excessive water-drinking, according to Priessnitz's original plan, is apt to cause dyspeptic troubles, water is now, in general, used internally only either for dietetic purposes, or to assist in other courses of treatment.

The *external use* of cold water admits of a very great variety of applications, and a corresponding variety of effects on the body. The two main effects of the different forms of cold baths are *abstraction of heat*, with its further influences on the functions of the body; and *stimulation of the cutaneous nerves*, and through these of the nerve-centres. The two effects are usually combined, but in some forms of bath the stimulation or the *exciting effect* preponderates; in others the abstraction of heat, with its *calming* or *depressing influence.* Hence the different forms of baths, or rather hydrotherapeutic procedures, may be divided into *stimulating* and *calming*, but it is to be borne in mind that there is no strict line of distinction. With this limitation we may regard as *stimulating*—the *full* cold bath of short duration, the stimulating action of which is increased by motion of the water, be it natural or artificially imparted; the rapid wash-down, either by means of a large sponge, or a wet sheet, with or without friction; the spouting of the back, and the pail-douche; the needle-bath or circular shower-bath; the different forms of the rain-bath, and the usual shower-bath; the great variety of other douches; and the running or flowing sitz-bath. The immediate effects of these stimulating forms, in a constitution endowed with a certain amount of reactive power, are exhilaration, increased activity of circulation and muscular force, and improved appetite and digestive power. By altering the duration of the bath and the temperature of the water, the effects may be considerably modified, and thus adapted to different conditions. In adult, as well as young persons, most beneficial effects are often produced by the combination of warm baths with cold douches on the spine.

The more *calming* forms are—the wet sheet-envelope, entire or partial; the impermeable wet compresses; the full cold bath of long duration and without motion; the sitz, the shallow, and foot baths without motion; and the full bath of higher temperature. Depression through abstraction of heat exceeds the stimulation in these forms: diminution of nervous irritability, of sensation and mental activity, and of the frequency of the pulse and energy of circulation; a feeling of lassitude; and a tendency to sleep, are the principal effects. These forms can, however, be modified, and the effects vary in proportion. Thus the wet sheet-envelope allows ample variation by using warm or cold water, by using the sheet dripping or wrung out, by making it fit tightly round the neck, by moving it to and fro, by frequently changing it, &c. The calming and stimulating form may be further combined by using, first, the wet sheet-envelope, or the woollen blanket-envelope, for a sufficient period to produce perspiration; and then a more or less cold bath or shower-bath of short duration. The physician has, indeed, infinite varieties of application at his disposal, to be used according to necessity.

Powerful and most important hydrotherapeutic helps are the different vapour and hot air-baths (Russian, Roman, Turkish baths), combined with douches and baths of various temperatures. These kinds of baths are, however, treated of in another article. *See* BATHS.

A plain nourishing diet, without or with only a limited amount of stimulants; outdoor exercise in proportion to the strength of the individual; and in some cases massage, in others active or passive gymnastics, are likewise to be regarded as valuable adjuvants in the hydrotherapeutic treatment of chronic diseases. For massage and muscular exercise mean not only increased action, oxidation, excretion, and development of muscle, but also increased general circulation and respiration, increased inhalation of oxygen, and increased production of heat, so necessary in the cold water-cure. There is also no reason whatever why suitable pharmaceutical remedies should not be combined with the water-cure treatment—a method which, as already mentioned, is frequently adopted in the best establishments.

Therapeutic Effects, and Morbid Conditions Suitable for Hydrotherapeutic Treatment.—The principal results of well-adapted courses of cold-water treatment are: improved nutrition and action of the skin; increased tone of the nerve-centres; regulation of the circulation; amelioration of the sanguification and nutrition; and acceleration of the retrogressive tissue-changes. It is essential for such successful results that the organism be able to stand a certain amount of abstraction of heat; that it be capable of more or less energetic reaction; and that the digestive and assimilative organs be able to take up a fair amount of nourishing material, which is required by the increased demand on the body.

Acute febrile diseases.—Amongst the oldest therapeutic uses of the cold bath, though it has only lately been more extensively revived, is the employment of different forms of cold baths in acute febrile diseases, attended with a high degree of pyrexia. The moderately cold or the cooled-down bath, as proposed by Dr. von Ziemssen of Munich, is the form principally employed; but cold affusions, the shower-bath, the wet envelope frequently changed, cold compresses, the application of ice in substance, washing with iced water, and iced enemas, are likewise applicable; and the liberal internal allowance of cold water forms an important part of the dietetic management of this class of diseases.

Typhoid fever.—Typhoid fever is the disease in which this treatment, with numerous modifications, has been most generally adopted. As soon as the temperature of the patient reaches 102·2° to 103° F., he is placed in a bath of about 90° F., and the temperature is gradually cooled down, by the addition of cold water, to 80° or 60° F., according to the patient's power of reaction. The patient is kept in the bath generally from 10 to 15 or 20 minutes, when slight shivering often manifests itself. The patient's temperature, measured in the rectum, is usually reduced by this procedure about 1½° to 5° F., not immediately, but within the first hour after the bath. As often as the temperature may again reach 102·2° to 103°, the patient is again placed in the bath. Thus, during the height of the pyrexia three to five baths may be required in twenty-four hours, while later on about two are usually sufficient, and often only one. Instead of the bath gradually cooled down, a bath of a temperature between 60° and 90° F., may be given, according to the condition of the individual patient. The frequent and careful use of the thermometer is an essential element in this method of treatment, which may be, as it often is, advantageously combined with the administration of alcohol, quinine, and other remedies. The earlier the baths are commenced, the greater seems to be their influence in mitigating the severity of the disease and its sequelæ, and in shortening its duration. In the numerous accounts of German physicians (Brand, Ziemssen, Zimmermann, Jürgensen, Liebermeister, &c.) it is claimed that the mortality is considerably less with this than with the expectant or any of the other usual modes of treatment.

Hyperpyrexia.—A still bolder use may be made of the cold-water treatment in those rarer cases of hyperpyrexia occasionally occurring in the course of rheumatic fever, when the temperature rises to 108° F. and more; and where very cold and prolonged baths, the application of ice-bags, &c., appear to be the only means of saving life. The same treatment is likely to be useful in some forms of sunstroke; and also in some cases of hyperpyrexia arising from other acute disease than rheumatic fever. (*See* the late Dr. Wilson Fox's *Treatment* *of Hyperpyrexia*; the writer's case in the *Clinical Society's Transactions*, vol. v.; and several other papers in the *Clinical Society's Transactions.*)

Scarlet fever.—In scarlet fever the writer has found warmer baths (80° to 98° F.) more generally applicable than quite cold or cooled-down baths, though in cases attended by a high degree of pyrexia and brain-symptoms these are preferable.

Hectic fever.—In hectic fever, connected with various chronic diseases, the effect of hydrotherapeutic treatment is less decided, and not yet sufficiently tested.

Digestive derangements of the most different kind, associated with *sluggish venous circulation* in the abdominal organs—conditions which may be grouped together under the term *abdominal venosity*, tendency to hæmorrhoids, to hypochondriasis, &c., are often the objects of the water-cure, which may be useful by stimulating the physical and psychical energy of the nervous system, as well as the nutrition and tissue-change, by invigorating the skin. Habitual constipation from this cause is often relieved by the hydrotherapeutic belt. In this class of cases the common salt waters, and the alkaline sulphated waters are more frequently used, and are often preferable; they may, however, be advantageously combined with judicious hydrotherapeutic treatment.

Chronic metallic poisoning may be treated in some cases with equal benefit, if there is sufficient reactive power, at cold-water establishments, as at the thermal sulphur and simple thermal spas. The external hydrotherapeutic procedures, aiming at increased perspiration and tissue-change, are in this class aided by the abundant internal use of water, in order to wash out the tissues, and especially the liver.

Skin-weakness or *atony of the skin* is often the cause of frequently recurring attacks of diarrhœa with neuralgic pains, of tendency to catarrh of the respiratory mucous membrane, and of rheumatism. Gently stimulating hydrotherapeutic appliances, with gradually increasing energy, are here mostly useful, unless, as in impeded convalescence, the reactive power is so reduced that the gaseous thermal salt-baths and mountain-air are preferable, while in other cases sea-air and sea-baths are successful competitors of the water-cure.

Hysteria.—In hysteria and hysterical affections the water-cure has obtained many good results, not by the internal use of water, but by the milder forms of baths. Functional hyperæsthesia and anæsthesia, hemicrania, spinal irritation, intercostal neuralgia, and other forms of neuralgia depending on imperfect nutrition and tissue-change, are likewise often benefited.

Organic diseases of the nerve-centres are not suitable for treatment in cold-water establishments, excepting occasionally for palliative purposes.

Rheumatism and gout.—In *muscular rheumatism* the original supporters of the water-cure considered their plan as infallible, but this is by no means the case. The diaphoretic methods, namely, the woollen blanket-pack and the wet sheet-envelope, often prove useful; but we know also of many failures in even good establishments. The exposure to all weathers during the cure ought certainly not to be imitated by such invalids, and the access of cold air to the wet body is to be more carefully avoided than it often is. The course must not be prolonged too much at one time, but may be repeated after an interval of months, which may be spent with advantage at sheltered seaside localities, at moderate elevations, with the help of pine-leaf baths, or at one of the gaseous thermal saline spas.

Rheumatic and *gouty swellings* of joints require great care in their management. The enfeebled invalid is rarely a fit object for the ordinary water-cure; but the stimulating local compress, more or less impermeable, is a useful element in the treatment of such cases.

Milder cases of *gout* may expect benefit from the usual hydrotherapeutic treatment, in so far as it aims at increased retrogressive tissue-change, and invigoration of the nervous system, especially if this treatment is associated with great moderation in the use of stimulants, and also of food in general; but local packing not rarely causes fits of gout. The more serious forms of gout are too much complicated with various defects of constitution to encourage us in recommending cold-water treatment.

Chronic affections of the skin.—In some diseases of this kind, such as prurigo, urticaria, eczema, and local perspirations, a more or less modified hydrotherapeutic treatment is an important adjuvant.

Syphilis.—The favourable results obtained in syphilis, or rather in the often complicated conditions of *lues*, have greatly contributed to the reputation of the water-cure; but the latter is only an excellent adjuvant to medicinal treatment in these cases, in a similar way as the sulphur waters are; and many of the cures of so-called *lues* may be regarded as cures of *mercurialism.*

Catamenial irregularities are not rarely treated at hydrotherapeutic establishments. Profuse menstruation is often checked by the regular use of the cold hip-bath of short duration, namely, three to five minutes; in insufficient menses, on the other hand, warm hip-baths of ten to fifteen minutes' duration are frequently useful, combined in some cases with the wet sheet-envelope; and dysmenorrhœa is likewise occasionally treated with advantage by the partial wet sheet-envelope.

This list of morbid conditions which may be more or less benefited might easily be increased. This is not astonishing if it is considered that hydrotherapeutic treatment can be infinitely modified and adapted to the powers of the constitution; and that it may be assisted by varying hygienic, climatic, dietetic, and medicinal influences. For we must reiterate that there does not exist any antagonism between hydrotherapeutic and other rational treatment, the former being, in fact, only part of the latter. Hence, however, it is also evident that the treatment in well-arranged hydrotherapeutic establishments ought to be under the guidance of the most intelligent physicians, just as is the case at all the best spas. Indeed the physician to such an establishment ought to be of a high class, possessing in a more than usual degree the gift of recognising all the individual peculiarities of the constitution, especially the amount of reacting power, adapting the principal remedy to every individual case, and combining other elements of treatment with hydrotherapeutic management wherever this is necessary. In the same way as we demand in suitable cases the administration of other remedies together with water-treatment in hydrotherapeutic establishments, so we must also express a wish that, apart from such establishments, hydrotherapeutic elements should be more generally combined with the usual medical treatment. For this purpose it is to be desired that well-conducted establishments should be in or near large towns, in order that persons following their usual occupations might undergo certain kinds of treatment at such establishments, or that attendants from such establishments might be sent to the houses of invalids.

HERMANN WEBER.

HYDROTHORAX (ὕδωρ, water; and θώραξ, the chest).—Dropsy of the pleura. *See* PLEURA, Diseases of.

HYDRURIA (ὕδωρ, water; and οὖρον, urine).—A profuse flow of watery urine. *See* URINE, Morbid Conditions of.

HYÈRES, France.—Town three miles from the sea. Mean winter temperature, 55° F. Well sheltered; little rainfall. *See* CLIMATE, Treatment of Disease by.

HYGIENE (ὑγίεια, health).—The science and art which relate to the preservation of health. *See* PERSONAL HEALTH; and PUBLIC HEALTH.

HYPÆMIA (ὑπό, under; and αἷμα, blood). Deficiency of blood in a part; a synonym for local anæmia. *See* CIRCULATION, Disorders of.

HYPÆSTHESIA (ὑπό, under; and αἴσθησις, sensation).—Diminished sensibility of a part. *See* SENSATION, Disorders of.

HYPERÆMIA (ὑπέρ, over or excessive; and αἷμα, blood).—Excess of blood in a part. *See* CIRCULATION, Disorders of.

HYPERÆSTHESIA (ὑπέρ, over; and αἴσθησις, sensation).—Increased sensibility of a part. *See* SENSATION, Disorders of.

HYPERALGESIA (ὑπέρ, over; and ἄλγος, pain).—Undue sensibility of a part to painful impressions. *See* SENSATION, Disorders of.

HYPERIDROSIS (ὑπέρ, excessive; and ἱδρώς, sweat).—Excessive perspiration; also termed *idrosis*, *ephidrosis*, and *sudatoria*. *See* PERSPIRATION, Disorders of.

HYPERINOSIS (ὑπέρ, over; and ἴς, ἰνός, flesh).—Excess of fibrin in the blood. *See* BLOOD, Morbid Conditions of.

HYPERMETROPIA (ὑπέρμετρος, beyond measure; and ὤψ, sight).—A congenital or acquired error of refraction of the eye, in which, owing to low refractive power of the dioptric media, or too little convexity of the refracting surfaces, or unnatural shortness of the antero-posterior axis of the eyeball, parallel rays of light do not, while the accommodation is in repose, converge to a focus on the layer of rods and cones of the retina, as in the normal or emmetropic eye, but to an imaginary point somewhere behind. It is the opposite of myopia, and is sometimes called hyperopia or hyperpresbyopia. *See* VISION, Disorders of.

HYPEROPIA (ὑπέρ, above; and ὤψ, sight).—*See* HYPERMETROPIA.

HYPERPLASIA (ὑπέρ, over; and πλάσσω, I mould or form).—An excessive growth of normal tissue-elements, which may lead to hypertrophy, or to the formation of distinct tumours. *See* HYPERTROPHY; and TUMOURS.

HYPERPRESBYOPIA (ὑπέρ, above; πρέσβυς, old; and ὤψ, sight).—*See* HYPERMETROPIA.

HYPERPYREXIA (ὑπέρ, excessive; and πυρεξία, fever).—Excessive pyrexia. *See* FEVER; and TEMPERATURE.

HYPERTROPHY (ὑπέρ, over; and τροφή, nourishment).

DEFINITION.—The word 'hypertrophy' signifies excessive nourishment, but is in practice used to designate the result of excessive nourishment—that is, excessive growth. It must be carefully distinguished from mere enlargement, and only spoken of where there is a real increase in a part, or, at least, in a tissue, without alteration of quality. Hypertrophy may be *general* or *partial*.

I. General Hypertrophy.—General

hypertrophy, though a remarkable condition, is of little practical importance. It is known only in those individuals of enormous size who are called 'giants.' The production of giants depends on causes entirely unknown, since it is noticeable that this condition commonly affects only one in a family, and is in its most conspicuous forms not hereditary. Giants are usually of feeble constitution, and deficient in procreative power. The name *macrosomatia* has been given to a condition equally unexplained, in which the whole body becomes enlarged in a monstrous degree. This condition has been observed to be in some instances congenital, or, at least, to begin in very early life. True general hypertrophy does not appear to be capable of being produced by any artificial means, since excessive feeding either produces hypertrophy almost confined to one tissue—namely, fat—or else fails to produce any enlargement at all.

II. Partial Hypertrophy.—By this is meant (*a*) excessive increase of any part of the body during the period of natural growth, either in intra-uterine or extra-uterine life; or (*b*) increase of a part already completely formed. According to this distinction hypertrophy may be classified as either (1) *congenital* or (2) *acquired.*

1. CONGENITAL HYPERTROPHY.—Congenital hypertrophy is that condition in which some part of the body begins from the first to grow so rapidly as to attain a size far beyond the normal. This condition has been seen to affect one side of the body, or one limb only, which thus becomes much larger than its fellow on the other side. Such a condition might be in theory difficult to distinguish from atrophy of the opposite side, or of the other limb—that is, from hemiatrophy (*see* ATROPHY); but in general the hypertrophic side is so far beyond the normal size as to prevent ambiguity. One remarkable case is on record in which one leg and arm assumed the proportions of those of a giant, whilst the other remained unaltered. Sometimes a congenital hypertrophy occurs without this unilateral character, as in the case reported by Mr. Curling of a girl aged fifteen, who had several fingers of both hands enlarged in an extraordinary degree without any assignable cause, the equality of the two sides being nevertheless preserved. Such instances, although unexplained, must, it would seem, be put into the same class as the gigantic growth of the whole of the body. Hypertrophy of special tissues is also sometimes congenital, as of the skin in ichthyosis. Hypertrophies similar to those here called congenital may occur, though rarely, in adult life. The enlarged part is found to be highly vascular, to have an increased temperature, and to preserve its normal proportions. The cause is in these cases equally unknown.

2. ACQUIRED HYPERTROPHY.—Acquired hypertrophies may be classified as follows:—

(*a*) *Recuperative*, consequent on increased work.

(*b*) *Defensive*, arising from pressure or inflammation.

(*c*) *Nutritive*, from increased supplies of food.

(*d*) *Apparently spontaneous* or of unknown cause.

(*a*) *Recuperative.*—Some organs and tissues are so constructed that increased functional activity causes hypertrophy. This is especially the case with the muscles. It is a matter of familiar observation that voluntary muscles increase in size when much employed, as is seen in the often-mentioned arm of the blacksmith or the leg of the ballet-dancer. In order to produce this increase, the exercise must be of a certain degree of intensity, but not excessive. It must be frequently repeated, with intervals of rest; and at the same time the nutrition of the whole body must be good. In the absence of these conditions, exercise is more likely to produce wasting. The explanation of this familiar process is still obscure.

Hypertrophy of the heart occurs in cases where that organ is made to work at a higher tension than the normal, and this higher tension can only result from increased resistance to the flow of blood, either at one of the orifices of the heart, or in the peripheral vessels. Hence the conditions most commonly giving rise to it are valvular disease, especially stenosis; and obstruction of the arteries, either by the thickening of their walls, or by contraction of their muscular coats. The right side of the heart will also become hypertrophied when any condition whatever hinders the passage of blood through the lungs. Disease of the kidneys is a frequent cause of enlargement of the left ventricle of the heart, though in what way is still a matter of discussion. It is only quite clear that the kidney-disease in some way increases the resistance in the smaller arteries and capillaries of the body generally.

Hypertrophy of the smooth or involuntary muscular fibres also occurs whenever that tissue has to contract for a long period under a higher tension than the normal. Thus the walls of the bladder become thickened in cases where, from obstruction of the passages, the evacuation of urine is effected with more difficulty, and under a higher pressure, than usual. In the same way the walls of the stomach, the œsophagus, and the intestines become hypertrophied in cases of obstruction to the passage of food through the alimentary canal.

The explanation commonly given of these cases of hypertrophy in the contractile organs is, that in consequence of obstruction the organ has to contract with greater force than usual, and thus becomes hypertrophied in the same manner as a voluntary muscle which is frequently exercised. It is, however, clear that this so-called explanation does not account for the connexion between obstruction and more powerful contraction. The only explanation that can be given is that in these cases pressure or tension on the organ itself is the stimulus to contraction, and that the force of contraction appears to depend roughly upon the strength of the tension which produces it.

There is less evidence that nervous or glandular structures undergo hypertrophy in consequence of their increased use; but if one kidney be destroyed the other is generally found enlarged; and some authorities believe in an increase in the size of the brain from mental activity.

(*b*) *Defensive hypertrophy* is the natural reaction of certain tissues against slight injury or irritation, whereby they become increased and serve the purpose of protection. But if the injury be excessive, atrophy or destruction of tissue results.

Pressure, which is a mild form of irritation, produces, when moderate and intermittent, hypertrophy of the external integument; but some regions of the skin are much more affected by this cause than others. Besides the epidermis, the coverings of certain internal organs sometimes show the same phenomenon, as the capsule of the liver from pressure of a belt, and certain parts of the pericardium where friction occurs. The defensive character of these processes is obvious.

Inflammation does not cause hypertrophy of organs generally, but only of tissues, and among these only of the connective tissues. In most tissues, *e.g.* muscular, nervous, glandular, the only result of inflammation is atrophy or destruction, with loss of functional power. But it seems to be a general law that moderate inflammation, chronic or intermittent, of connective tissue causes it to increase. Purely fibrous structures, such as serous membranes, become thickened by chronic or repeated inflammation of moderate intensity, especially if suppuration be not produced, but this increase is not always permanent. In periostitis the formation of new bony tissue causes the increase to be permanent, and thus hypertrophy of bone is a frequent consequence of inflammation. The increase of connective tissue from irritation is obviously a conservative or defensive process, placing a barrier to the extension of injurious agents; and forming a capsule round foreign bodies.

Increase of connective tissue is also constantly present in chronic interstitial inflammation of solid organs, where indeed it is often impossible to draw the line between inflammation and fibrous overgrowth. These changes, being produced by some irritation or injury, illustrate the law of the dependence of increase of connective tissue upon such causes; but since there is generally simultaneous or consequent atrophy of the other tissues of the organ, there is likely to be rather a diminution than an increase in the size of the organ or part generally.

(*c*) *Nutritive hypertrophy.*—It must be regarded as doubtful whether increased nourishment alone is capable of producing enlargement of any part of the body. It certainly does not necessarily do so, as is shown by the case of experimental hyperæmia. When this condition is produced, for instance, by section of the cervical sympathetic nerve, in one side of the face and head of an animal, hypertrophy is only a rare and occasional consequence. When, however, the increased supply of nutrition in the form of blood is combined with some irritation or functional stimulus, we often find hypertrophy result. Thus, for instance, reflex hyperæmia of the skin of the face, or blushing, which is produced by numerous internal causes, such as gastric or uterine derangement, may subsist for years and reach a very high degree without altering the nutrition of the part. But if there should be in addition some disturbance or inflammation of the glands of the skin, we have the conditions called *acne rosacea*, &c., in which hypertrophy is an important element. Almost the only instance that can be quoted of hypertrophy from increase of blood-supply alone is that of the corpus luteum during pregnancy, when the ovary participates in the functional hyperæmia of the uterus. The well-known experiment of Hunter should also not be forgotten, in which he transplanted the spur of a cock from its foot to its head, and found it to increase in size.

It is, however, important to remember that hypertrophy, however produced, is always accompanied by an increased supply of blood, and enlargement of the vessels.

Special nutrition.—It is well known that abundant supplies of amylaceous and fatty food, especially with a full allowance of water, cause hypertrophy of the adipose tissue. It is also said that small doses of phosphorus favour the growth of bone in young animals. But there is no other instance in which it is known that any special food causes hypertrophy of any special tissue.

(*d*) *Apparently spontaneous or physiological hypertrophy.*—Physiological hypertrophies form an important class. One of the best instances is that of the enlargement of the uterus during pregnancy. This enlargement is clearly not the consequence of hyperæmia alone, nor of increase of the functional activity in the muscular walls, though both these conditions are present; but must proceed from some direct physiological stimulus like that which determines the growth of the embryo itself. The hypertrophy affects all parts of the organ—its mucous and serous coats, as well as the muscular walls. Enlargement of the mammæ appears to arise from similar causes; and it is even probable that swelling of the thyroid may, through some obscure connexion with the sexual organs, be caused in the same way. Some instances of hypertrophy we cannot in any way explain, such as the apparently spontaneous enlargements of the tonsils, spleen, and thymus gland which are sometimes observed. These changes have been explained by a supposed derangement of the so-called *trophic nerves*, but this explanation only puts the difficulty a little further back.

Process of Hypertrophy.—It has been a question whether hypertrophy depends upon the increase in the size of the minute elements of an organ, or only on increase of their number. There can be no doubt that the former change often occurs. Thus, in the pregnant uterus the muscular fibres have been found from seven to eleven times as long as natural, and from twice to seven times as wide. In a remarkable case of enlargement of the nerves, described by the late Dr. Moxon, the nerve-fibres were found to be on an average three times and some of them even forty times as large as normal. When enlargement of one kidney takes place as a consequence of destruction of the other, the tubules and Malpighian tufts are found greatly increased in size. In hypertrophy of the heart, the muscular bundles are found to be thickened, though the fibrillæ are unchanged; but in most cases multiplication of the tissue-elements is the chief cause of the increase in size. To this latter process Virchow gives the name of *hyperplasia*, and it is important to remember that, though constantly occurring in hypertrophy of organs, it does not necessarily lead to the latter change.

'False' Hypertrophy.—The term *false* hypertrophy is sometimes used for a process in which an organ becomes outwardly increased in size, owing to the deposition within it of some foreign material, or to mere distension. Thus in a fatty liver the real liver-tissue is wasted, but is replaced by fat. An emphysematous lung appears to be increased in size, but has actually suffered atrophy. The substance of the brain in hydrocephalus may be greatly reduced in volume, though the head appears of enormous size. The very remarkable disease called 'Duchenne's paralysis' is an instance of apparent hypertrophy of the muscles, through deposition of fat between the fibres, but the term is hardly needed, except as a caution.

TREATMENT.—It is obvious that no general rules can be laid down for the treatment of hypertrophy. When it is connected with increased functional activity, it is usually a favourable rather than a hurtful condition, though in some cases it may appear that the hypertrophy more than compensates the deficiency or irregularity by which it is produced. But even if this be so, the cure of excessive hypertrophy is not within our powers. The utmost that can be done is to endeavour, if possible, to check the process by which the hypertrophy is produced. It is, however, well to point out that when functional hypertrophy has resulted from some obstacle or undue resistance, it may entirely subside when that resistance is removed. Thus if the uterus have enlarged around a fibrous tumour, it may regain its normal bulk when the tumour is removed; and we sometimes see a sensible diminution in the size of a hypertrophied heart when the derangements which produce it no longer act. Moreover, hypertrophy may be completely reduced by a general lowering of the nutrition of the body. Thus, in early stages of pulmonary phthisis, the heart may be hypertrophied; but when death occurs in a late period of the disease, the organ is rarely found enlarged, and is even wasted; though, according to Dr. Peacock's tables, less so than in other wasting diseases.

J. F. PAYNE.

HYPINOSIS (ὑπό, under; and ἴς, ἰνός, flesh).—Deficiency of fibrin in the blood. *See* BLOOD, Morbid Conditions of.

HYPNOTICS (ὕπνος, sleep).—Measures or agents employed to induce sleep. *See* NARCOTICS.

HYPNOTISM (ὕπνος, sleep).—A synonym for Braidism. *See* BRAIDISM; and MESMERISM.

HYPOCHONDRIAC REGION (ὑπό, under; and χόνδρος, a cartilage).—This region is double, right and left, occupying the upper part of the abdomen on either side of the epigastrium, and partly corresponding to the lower regions of the chest, being almost, and in some cases entirely, covered in by the ribs and their cartilages. Each hypochondrium is bounded below by a horizontal line at the level of the ninth costal cartilage; and internally by a vertical line from the eighth cartilage downwards. The organs situated in the right hypochondrium are the liver and gall-bladder mainly; with, more deeply, the pyloric end of the stomach, part of the duodenum, and the hepatic flexure of the colon. In the corresponding left region lie the spleen, a small portion of the left lobe of the liver, the fundus of the stomach, the tail of the pancreas, and the splenic flexure of the colon. The gastro-splenic fold of peritoneum, with its vessels, passes from the stomach to the spleen.

CLINICAL INVESTIGATION.—It must be borne in mind that morbid conditions within the chest not uncommonly originate clinical phenomena, both subjective and objective, in connexion with one or other hypochondriac region, and these must always be taken into consideration when investigating any particular case. In making a diagnosis, no reliance whatever can be placed on mere sensations referred to these regions, but physical examination is in every instance required, in order to determine the conditions present, and especially palpation and percussion. Moreover, it must be remembered that disease of an important and serious nature may arise without the occurrence of any unusual feelings. Pain of various kinds is often complained of, and when referred to the right hypochondrium is usually supposed to be connected with the liver; but it may depend upon affections of the superficial structures; peritonitis; right pleurisy or pneumonia; or conditions associated with the gall-bladder, pylorus, duodenum, or colon. A characteristic pain starting from this region is that of hepatic colic, usually due to the passage of a gall-stone along the ducts. Persons who are hypochondriacal not uncommonly refer some abnormal sensation to their right hypochondrium, for which there is really no obvious cause. In the left hypochondrium pain may also be due to affections of the walls, or of structures within the thorax; of the cardiac end of the stomach; of the colon; or, in exceptional cases, of the spleen.

The morbid conditions which are capable of originating abnormal physical signs in the hypochondriac region may also be either thoracic or abdominal. Of the former, pleuritic effusion is the most frequent; and on the right side this condition may cause marked depression of the liver, as also may pneumothorax. In exceptional instances the heart is so enlarged as to reach the left hypochondrium; and the writer has met with a case in which a large thoracic aneurysm presented in this region. As regards abdominal diseases occupying the right hypochondrium, abnormal physical signs are usually associated with the liver, which is altered in position, shape, size, or physical characters. Occasionally they are connected with the abdominal walls; the gall-bladder; or the stomach, duodenum, or colon. On the left side enlargement of the spleen is the main condition discovered by physical examination; but the stomach may also give signs of distension in this direction, or of organic disease of its walls. Exceptionally the colon may present abnormal physical signs. Growths may originate here in connexion with the peritoneum; and the writer has met with a case in which a growth started from the left hypochondrium, probably of a malignant nature, and involving more than one structure, but it was impossible to say where it commenced. Of course the hypochondria are involved along with other regions in general enlargement of the abdomen; and organs from other regions may so increase in size in certain diseases as to extend into one or both of these regions.

Frederick T. Roberts.

HYPOCHONDRIASIS (ὑπό, under; and χόνδρος, a cartilage).—Synon.: Fr. *Hypochondrie*; Ger. *Hypochondrie*.

Description.—The term 'hypochondriasis' is derived from an ancient hypothesis that the symptoms of this disorder were due to perturbations of natural force generated in the liver and pylorus, to which idea the frequent prevalence of flatulence in the disorder conduced. The condition thus called is really a disease of the nervous system. It is a form of mental unsoundness closely allied to melancholia, of which, indeed, it often forms the initiatory stage. It is characterised by a morbid anxiety, either without any, or having only very slight, foundations, relative to the state of physical health. The patient thinks about his health unduly, observing himself with restless care, examining especially the characteristics of his secretions, translating into evidence of progressive organic mischief every trivial departure from perfect action of his organs, and becoming more and more absorbed in precautions against the malady with which he believes himself affected. Nothing that happens tends to the side of reassurance. If his sleep be disturbed, the symptom may be portentous, he thinks, of brain-softening; if it be sound, the patient, instead of being comforted, fears apoplexy. Constipation of the bowels signifies obstruction; a slight diarrhœa implies coming exhaustion. Everything which he reads or hears in reference to disease, the patient applies to his own case, examining himself on every point thus presented to his mind, and rarely failing to find something which dovetails with symptoms of his own. For he recognises only the points of resemblance; the features of difference are unconsciously ignored. In some cases the patient is constant in referring his troubles to one particular organ. Year after year his story is the same: it is his stomach, liver, brain, or some other organ, which is in fault; but always the same. In other instances there is a vacillation quite as remarkable. Routed, perhaps, by the convincing arguments of his adviser, he is forced to yield the position which he had assumed, but only to take an equally strong one in reference to some other part of his frame. These diversities strongly recall the fixed and shifting delusions of insanity. The patient is prone to wander from one doctor to another, often carrying with him a bundle of prescriptions and a long written list of questions, which must receive categorical answers. Apparently satisfied at the time, he speedily recollects some point upon which he has not received assurance, and this he conceives vitiates the whole of the explanation and advice which have been given to him, and he is plunged again into his previous state of anxiety and doubt. Where circumstances do not involve forced labour for existence, the patient passes his time in chasing his health, which is always contriving to elude his grasp. If he holds an appointment, he will resign it in order to have full opportunity for studying himself; and his occupation once gone, he finds too late that it was his best friend, and he then ascribes to his forced idleness all the ills which had induced him to seek retirement.

In many cases the most careful examination can discover no signs of disease, and the patient wears the aspect of health; or there may be a worn, anxious look. In others there may be, especially in the digestive organs, slight deviations from perfect integrity, which explain some of the symptoms, but not the exaggerated apprehensions to which they give rise.

Hypochondriasis is a chronic disorder. It may continue, and this most frequently, as a harmless peculiarity attached to a life which is not perceptibly shortened in length, though often sadly diminished in utility and happiness, by its symptoms. Or there may be an improvement practically amounting to a cure, which will endure for a longer or shorter period. In the decline of life, however, there is very apt to be a return of symptoms. Or hypochondriasis may pass into true melancholia, and then the bodily health, previously the constant object of solicitude, improves wonderfully. Indeed, nothing more is heard about it.

Ætiology.—Hypochondriasis is very much more common in the male than in the female sex. The period of life most prone to it is from 20 to 40 years of age. It is apt to occur in those who inherit a tendency to insanity, and the disease in its own peculiar form is often hereditary. Excesses of various kinds, especially on the side of the sexual system, will precipitate the appearance and intensify the symptoms of the affection, but it is doubtful whether they can altogether originate it. The same may be said of gout, which is apt to be associated with the condition and to complicate its symptoms. Depressing moral circumstances also are not without influence in determining an onset of hypochondriasis in those predisposed to it. This is especially true of mental strain. The frequent occurrence of some deviation from healthy condition in the liver, stomach, or bowels, which is noted in these cases, would suggest that, probably through an interruption to the perfect nutrition of the body, diseases of these viscera bear their part in the causation of hypochondriasis. The intercurrence of internal hæmorrhoids with bleeding is very common, and this would manifestly tend to keep up, if it did not originate, the disease. Stricture and chronic ulcer of the intestines are occasionally associations which probably also influence the appearance of hypochondriasis.

Anatomical Characters.—There are no anatomical characters peculiar to the disease.

Diagnosis.—When careful examination, which must never be omitted, has disproved the existence of organic disease tending to produce the symptoms described by the patient, it sometimes becomes a question whether the case is one of hypochondriasis or of melancholia.

In the former there is no tendency to suicide; on the contrary, a strong desire to live pervades the sufferer's mind, and impels him to endless search for the cure of his ailments. He delights in consulting medical men and entering into the minutest details which he thinks can aid them in helping him. Up to a certain point his story is frequently characterised by a logical accuracy, which fails him, however, in some point of great importance, by which the conclusions are invalidated. The melancholic patient, on the other hand, is often suicidal and always despairs of any relief to his condition, the description of which, as given by him, is confused, frequently incoherent, and unintelligible.

Prognosis.—Early and marked hypochondriasis occurring in a person with a strong hereditary taint of insanity, without any definite cause of mental depression, is of ill omen. Such a case very often drifts into melancholia.

The prognosis is more favourable, perhaps, the less strongly marked the hereditary predisposition and the more evident and adequate the immediate causes to which the patient has been exposed, the most potent of which are sexual or alcoholic excesses, mental strain or shock, or the sudden change from a life of activity to one of forced and, as the sequel shows, uncongenial leisure.

Treatment.—Moral treatment is alone of any influence in a large majority of cases. Where there is, however, manifest anæmia, a history of syphilis, evidences of gouty malassimilation, accumulation of fæces, catarrh of the intestinal canal, or hæmorrhoids, the therapeutics proper to these conditions should be employed. Alcoholic stimulants should be avoided. Travel, especially under judicious companionship, and the encouragement of regular, definite, and useful employment for the attention and the physical powers, are the most potent means of treatment, by which the disease may be often much ameliorated, and sometimes cured. Ridicule of the patient's sufferings will rarely or never be of service, but at the same time a habit of prescribing for all the symptoms as they arise must be avoided. T. Buzzard.

HYPODERMIC MEDICATION

(ὑπό, under; and δέρμα, the skin).—Fr. *La Méthode Hypodermique* or *Sous-cutanée*; Ger. *Subcutane Arzneiapplication*; *Hypodermatische Injection der Arzneimittel.*

The introduction, by means of a sharp-pointed hollow needle, of alkaloids and other agents into the subcutaneous cellular tissue.

HISTORY.—Hypodermic injections were first employed by physiologists in experimental researches. John Hunter appears to have used them in this way, and they were certainly so employed as far back as 1819 by Magendie. Valleix made a crude attempt to apply sedatives subcutaneously in the treatment of neuralgia by means of acupuncture-needles; but, according to Bartholow, it was not till 1839 that the method was regularly employed in the treatment of disease, when Taylor and Washington in America made use of it, the idea being suggested to their minds by Lafargue's method of inoculation. Sieveking claims that Kurzak of Vienna was really the discoverer of hypodermic medication; but, be this as it may, it was undoubtedly the late Dr. Alexander Wood of Edinburgh who brought this method of treatment into general use.

METHOD OF APPLICATION.—This is a matter of great importance. With due precaution, the pain in most instances is insignificant. In the case of some drugs, such as ergotine, more or less pain is inevitable, but by careful manipulation the unpleasant effects may be reduced to a minimum. The needle, which must be sharp and smooth at its point, is attached to the nozzle of the syringe, and the latter is charged with the drug to be employed. If a tabloid is used, it is dissolved in a syringeful, or less, of warmish water; if, on the other hand, a solution of the drug is used, the syringe should be completely filled, and the quantity to be injected accurately gauged by moving the button down to the required mark on the piston. By either plan the possibility of overdosage is guarded against. A fold of skin is pinched up between the left thumb and index finger, and the needle is pushed firmly and sharply into the cellular tissue. The barrel of the syringe is then steadied between the right index and middle fingers, and the fluid slowly and steadily injected by pressure with the right thumb on the end of the piston. As the needle is withdrawn, the left index finger should be applied to the point of puncture for a few seconds. In the case of ergotine and a few other irritating drugs it is well to modify this mode of procedure by making the injection directly into the muscular tissue: in uterine hæmorrhage, into the gluteal muscles.

To prevent any chance of sepsis, some recommend that the needle before being used should be dipped into carbolised oil. *Local ill effects* consist chiefly in pain, phlegmonous swellings and consequent abscess, slight bleeding, or ecchymosis; but with proper precautions most of these accidents may be avoided, and in nearly all cases the pain is both trifling and evanescent. Certain parts of the body should always, if possible, be avoided in making hypodermic injections—*e.g.* regions where the subcutaneous cellular tissue is scanty, such as the skin over the tibiæ, parts such as the cheeks, forehead, ears, &c. It is well also to avoid the neighbourhood of large vessels. *General ill effects* may easily be produced from injections, especially of narcotics, in diabetics, alcoholics, and patients suffering from renal disease.

Solutions should be made with vehicles which fulfil the following conditions: (1) They should have as high a solvent power as possible. (Some substances, such as calomel, can only be injected in a state of suspension.) (2) They should, as far as possible, be permanent, not deteriorating by keeping. (3) They should be unirritating. Cherry-laurel water, carbolic acid, boric acid, camphor, and other substances, may in some cases be used to prevent the development of organisms. Paroleine (one of the petroleum series) is the best vehicle for the injection of antiseptics, such as carbolic acid, eucalyptol, iodoform, turpentine, &c. Tabloids and gelatine discs are convenient forms for use in preparing solutions.

INSTRUMENTS.—*For ordinary hypodermic use* a simply constructed and accurately graduated instrument is requisite. The capacity of the barrel should be twenty minims. The syringe may conveniently be had in a small case, with two needles, and a supply of silver wires to keep their canals clear. The *needles* are best made of golden platinum, which is both tough and non-corrosible. It is of great consequence that the points should be sharp and with smooth edges. The *nozzle* of the syringe, on which the needle is fitted when required for use by a simple sliding motion (not by a screw), should always be provided with a metal cap. This prevents drying and shrinking of the piston packing. The *packing* should consist of leather or wash-leather: and if by any chance it does not fit tightly, the top of the syringe should be unscrewed and removed, with the piston, and the packing is then to be well soaked in paroleine. The metal parts must not be attached to the barrel by cement, as this material is destroyed by ether and other fluids, and the syringe is consequently rendered utterly useless. The minims are best marked on the *piston*, which should have a screw-thread on which a button runs: by this means the dose is gauged accurately before the injection is made, and there is, therefore, no possibility of injecting more than was intended. The piston should have a simple sliding, and not a screw, action. It is terminated at the top by a flat knob, which is pressed with the thumb when the injection is made. For the injection of ether, alcohol, antiseptics, nutrients, saline solutions, &c., much larger syringes may be used to avoid multiple injections; such syringes are usually of a capacity of eighty to one hundred minims.

It is almost superfluous to add that hypodermic syringes must be kept scrupulously clean. After use, tepid water, to which an antiseptic may with advantage be added, should be drawn into the syringe and ejected through the needle. The latter should then be blown through, to expel any remaining fluid, and a silver wire is then passed through and left in its canal to keep it clear. The *barrel* of the syringe should consist of glass. Celluloid has been employed for this purpose, but it is soluble in ether and alcohol, and should therefore be avoided. The *cap*, *nozzle*, and *piston* should consist of nickelled metal or silver.

Advantages.—The advantages of the hypodermic method are numerous, and difficult to over-estimate; but it must be remembered that it has its limitations. There is, for instance, no useful end gained by the hypodermic injection of such drugs as Epsom salts, or of such powerfully irritating and depressing principles as colchicine and cantharidine. It is further important to point out that the hypodermic administration of such drugs especially as morphine and cocaine should be under the direct control of the medical man, and should in no case be entrusted to the patient. The advantages of the hypodermic, as contrasted with other methods of administering drugs, may be briefly summed up as follows: (1) There is greater rapidity of absorption, and consequently more speedy effect. (2) A rapid local as well as general effect can be more easily obtained. (3) Drugs can be administered in this way when other methods are impossible—*e.g.* in cases of vomiting, nausea, and other conditions originating in an irritable or diseased stomach; where there is mechanical difficulty in deglutition; and in certain cases of delirium, mania, or coma. (4) According to Eulenburg, drugs are less liable to produce a cumulative effect when injected subcutaneously than when administered by the mouth. (5) In cases of narcotic or other forms of poisoning, emetics hypodermically injected often produce a rapid and certain effect, when administration by the mouth is inadmissible.

Remedies used Hypodermically, and Diseases for which they are Employed.

Acidum Arseniosum—Arsenious Acid. See Arsenium.

Acidum Benzoicum—Benzoic Acid. Benzoic acid 10 grains; alcohol up to 112 minims. *Dose*, from 8 to 16 minims. *Used* in chest-diseases to stimulate the respiratory centre, and in the collapse of acute fevers and uræmia. The solution should be slightly warmed before injection.

Acidum Carbolicum—Carbolic Acid. Pure carbolic acid 1 or 2 grains; paroleine, or water, up to 112 minims. *Dose*, 8, 16, or 24 minims. Has been used in erysipelas, malignant pustule, and other infective diseases.

Acidum Scleroticum—Sclerotic Acid (obtained from ergot). The solution easily decomposes, and should be made as required. Twenty minims of a 4 per cent. solution, twice or thrice in the twenty-four hours, recommended by Ziemssen in hæmoptysis. Tabloids of $\frac{1}{2}$ to 1 grain are convenient for administration. The indications for the use of sclerotic acid are the same as those for ergotinin.

Aconitina—Aconitine. There are various aconitines, and these are of various strengths. Morson's is of uniform strength, and should be prescribed. The dose ranges from $\frac{1}{260}$ to $\frac{1}{60}$ of a grain. For a first dose the quantity should never exceed $\frac{1}{130}$ of a grain: aconitine (English) 1 grain; diluted sulphuric acid q.s.; distilled water to $\frac{1}{2}$ ounce. *Dose*, 1 to 4 minims (Martindale and Westcott). Tabloids ($\frac{1}{260}$ and $\frac{1}{130}$ grain) may also be used. *Uses*: In various forms of neuralgia, especially of the trigeminal. It has also been employed in cardiac hypertrophy, angina pectoris, intermittent and puerperal fevers; but in such cases it is preferable, as a general rule, to administer the tincture by the mouth.

Æther—Ether. Sulphuric ether is generally used for hypodermic purposes, but acetic ether may also be so used. Ether may also be injected in combination with alcohol; or camphor, 1 to 2 parts dissolved in sulphuric ether 10 parts, may be administered. *Dose* of sulphuric ether 20 to 40 minims, repeated as required (*see* remarks on Syringes). *Uses*: In collapse of any kind, in the exhaustion of typhus and other fevers, pneumonia, &c.

Alcohol in the form of brandy is very useful hypodermically in cases of collapse. *Doses* of half a fluid drachm to a drachm may thus be given at a time and repeated as required. It causes little pain.

Ammoniæ Liquor—Solution of Ammonia. Dose, 2 to 5 minims hypodermically or intravenously. The latter method is of service in syncope from any cause, and in threatened death from embolism.

Amyl Nitris—Nitrite of Amyl. Nitrite of amyl 1 part; alcohol 9 parts. *Dose*, 8 to 12 minims. *Used* in threatened death during chloroform anæsthesia, in puerperal convulsions, and in irregular (hour-glass) uterine contractions. Also in strychnine poisoning; and, especially, in angina pectoris.

Apocodeine Hydrochlorate. Recommended by Dujardin-Beaumetz as an emetic. *Dose*, $\frac{1}{5}$ to $\frac{1}{3}$ of a grain in 16 minims of distilled water.

Apomorphinæ Hydrochloras—Apomorphine Hydrochlorate. Dose, tabloids $\frac{1}{15}$ to $\frac{1}{10}$ grain; or 2 to 8 minims of the pharmacopœial 2 per cent. solution in camphor water may be given. An over-dose may kill by causing profuse bronchial secretion (Brunton). *Used* in various forms of poisoning as an emetic.

Aqua—Water. Large hypodermic injections of water, or of water with chloride and bicarbonate of sodium in solution, have been used in cholera, but intraperitoneal injections have been recommended in preference. Iced water has been used hypodermically to cure sciatica, and also in pyrexia. Hot water is sometimes useful in this way as an analgesic.

Arsenium—Arsenic, and its preparations. Arsenic causes slight local irritation. It may be used in the form of Fowler's solution (1 part to 2 parts of distilled water). It is of service in various nervous diseases—paralysis agitans, chorea, neuralgia, epilepsy, &c.; in skin diseases—lichen ruber, psoriasis, chronic eczema; in septic diseases—puerperal and typhoid fevers; in lymphoma, in various psychoses, and other diseases.

Atropina—Atropine. The neutral sulphate is the best salt. The solution used should be recent. Neutral sulphate of atropine 1 grain; distilled water up to 2 ounces, 160 minims (sixteen minims = $\frac{1}{70}$ grain). It is well to begin with $\frac{1}{150}$ grain. The prepared tabloids $\frac{1}{150}$, $\frac{1}{100}$, and $\frac{1}{60}$ grain are useful. *Used* in neuralgia, asthma (when the mucous membrane is not dry), enuresis, spermatorrhœa, intestinal obstruction, epilepsy, tetanus, for the relief of pain generally, as an antisudorific (especially in phthisical sweats), and as an antisialagogue. Is of great service in combination with morphine. *See* Morphine, p. 912.

Auri Chloridum—Chloride of Gold. Dose, $\frac{1}{35}$ grain in 20 minims of distilled water. Used in hysterical anæsthesia, and in syphilitic affections.

Caffeina—Caffeine. Caffeine 20 grains; salicylate of sodium $17\frac{1}{2}$ grains; distilled water to 1 drachm (3 minims = 1 grain). *Dose*, 1 to 6 minims (Martindale and Westcott). Tabloids of caffeine sodio-salicylate = $\frac{1}{2}$ grain, may also be used. *Used* in malarial neuralgia and rheumatism, megrim, insomnia, chronic alcoholism, hysteria, cardiac dropsy (on account of its diuretic action), asthma, and in poisoning by opium and its alkaloids and compounds, alcohol, and cocaine.

Calabarina, Physostigmatis Extractum—Calabarine, and *Extract of Calabar Bean.* Calabarine is not used hypodermically, but eserine (physostigmine) and the extract have been so employed. The best preparation is that of Martindale and Westcott. Extract of Calabar bean 10 grains; rectified spirit 10 minims; rub together till smooth, and add gum acacia 10 grains; mix, and add gradually distilled water to $\frac{1}{2}$ ounce. *Dose*, 3 to 12 minims. *Used* in tetanus, trismus neonatorum, strychnine poisoning, enuresis, &c.

Calomel.—See Hydrargyrum.

Camphor.—See Æther.

Chloroformum—Chloroform. Has been injected pure, in doses of 10 to 20 minims and upwards, as a substitute for morphine in neuralgia, lumbago, colic, cancer, &c.

Cocaina—Cocaine. One of the best, if not the best, of local anæsthetics. Injected hypodermically renders operations for hæmorrhoids, small tumours, &c., painless. To obviate toxic effects the re-crystallised salt should alone be used. The solution decomposes rapidly, and it should therefore be freshly prepared when required. Tabloids of $\frac{1}{6}$, $\frac{1}{4}$, and $\frac{1}{2}$ grain are convenient. In addition to its use as a local sedative, cocaine has been employed in hemicrania and melancholia, to overcome the craving for morphine and alcohol, and to relieve various forms of neuralgia.

Codeina—Codeine. The hydrochlorate is the best salt for hypodermic use. *Dose*, $\frac{1}{8}$ grain to $1\frac{1}{2}$ grain. Codeine hydrochlorate 1 grain; distilled water up to 128 minims (16 minims = $\frac{1}{8}$ grain). *Used* in diabetes mellitus; also in gastrodynia, insomnia, cancer, and asthma.

Conina—Conine, and its salts. Hydrobromate of conine 1 grain; distilled water 20 minims. *Dose*, 1 to 3 minims. *Used* in asthma, angina pectoris, pertussis, laryngismus stridulus, tic-douloureux, chorea, mania (Crichton Browne). Useless in tetanus and strychnine poisoning.

Curara—Curare. Is best given hypodermically. *Dose*, $\frac{1}{10}$ grain in 1 per cent. filtered aqueous solution, or a tabloid ($\frac{1}{12}$ grain). *Used* to control the spasms of tetanus and hydrophobia.

Daturina, Extractum Stramonii—Daturine and *Extract of Stramonium. Dose*, of daturine, $\frac{1}{100}$ grain; of stramonium extract, $\frac{1}{16}$ to $\frac{1}{5}$ grain. *Used* in emphysema, neuralgia, tetanus, and tremor (paralysis agitans).

Digitalinum—Digitalin. Must only be used in crystalline form; all other forms are impure and unreliable. *Dose*, $\frac{1}{100}$ grain tabloid. *Used* only exceptionally subcutaneously, in aconite poisoning, heart-diseases, spermatorrhœa, and exophthalmic goître (Bartholow).

Duboisina—Duboisine. Dose, $\frac{1}{350}$ grain. *Used* in exophthalmic goître (Dujardin-Beaumetz), phthisical sweats (Gubler and others), and asthma.

Ergotinina—Ergotinine. Ergotin is the watery extract of ergot. Ergotinine is the crystalline alkaloid. *Dose*, of Bonjean's ergotin 2 to 4 grains in glycerine and distilled water up to 20 minims; of ergotinine in tabloid $\frac{1}{300}$ or $\frac{1}{150}$ grain. *Used* because of its action on involuntary muscular fibre—(1) to contract the uterus; (2) to constringe blood-vessels in hæmoptysis and other forms of bleeding. Should always be deeply injected.

Ferrum—Iron. The pyrophosphate of iron with citrate of sodium (2 grains in 20 minims), and ammonio-citrate of iron in

2-grain doses and upwards, have both been strongly advocated for hypodermic use in anæmia. Very rarely resorted to.

Homatropina—Homatropine hypodermically is less efficacious than atropine. *Dose*, in tabloid, $\frac{1}{250}$ grain. *Used* to relieve cough, expectoration, and insomnia; also as an antidote to pilocarpine.

Hydrargyrum—Mercury, and its salts. The injection of the salts of mercury should only very exceptionally be resorted to, as the process is always painful and, without extreme care, is apt to result in inflammation and abscess. Where administration by mouth is, for any reason, undesirable, the endermic method by inunction with the oleates, or the oleates in combination with lanolin, is preferable to subcutaneous injection. The salts available for hypodermic use are the perchloride, the biniodide, the peptonate of mercury and ammonium, and calomel. If the perchloride is used, discs ($=\frac{1}{16}$ grain of sublimate) or tabloids ($=\frac{1}{60}$ and $\frac{1}{30}$ grain of sublimate) are most convenient. If a solution is desired, the following formula may be used: Perchloride of mercury 3 grains; chloride of sodium and hydrochlorate of cocaine, of each 1 grain; distilled water up to 336 minims (16 minims $=\frac{1}{7}$ grain of mercuric chloride).

The best solution of the biniodide is that of Martindale and Westcott: Injectio hydrargyri iodidi rubri, 1 in 64. *Dose*, 2 to 6 minims.

Calomel may be injected in doses of 1 or $1\frac{1}{2}$ grain suspended in pure liquid vaseline or paroleine, or Neisser's formula (modified) may be used: Calomel and sodium chloride, of each ʒiv.; mucilage of tragacanth ʒij.; distilled water ℥j ss.

Hyoscina—Hyoscine, and its salts. The effects of hyoscine are best produced by hypodermic use. The *dose* ranges from $\frac{1}{200}$ to $\frac{1}{25}$ grain. Tabloids contain $\frac{1}{200}$ and $\frac{1}{75}$ grain. The best solution is: Hyoscine 1 grain; distilled water 200 minims. *Used* in the treatment of delirium, excitement, and insomnia due to insanity and other diseases. Has been of service in the treatment of epilepsy and chorea. Of no use as an analgesic.

Injectiones Hypodermicæ Nutrientes—Nutrient injections are of very limited applicability. Almond, olive, and cod-liver oil may be thus employed. Sugar solution, egg albumen (alone or mixed with the yolk), milk, and defibrinated blood have all been injected subcutaneously, with more or less success. Blood-serum and salines have also been used. Milk has been injected intravenously, and sodium chloride intraperitoneally.

Iodoform may be given in solution in oil or ether, in doses of 1 grain and upwards. Iodoform 3 grains; sulphuric ether 15 minims; castor oil up to 32 minims. *Used* in scrofula, goître, rickets, phthisis, &c.

Morphina—Morphine, and its salts. The following salts are all more or less adapted for hypodermic use—acetate, tartrate, sulphate, hydrochlorate, and bimeconate. The pharmacopœial preparation contains the acetate. Morphine may be combined with cocaine or atropine: Cocaine hydrochlorate 3 grains; morphine hydrochlorate 1 grain; distilled water up to 224 minims—sixteen minims $=\frac{1}{14}$ grain of morphine and $\frac{1}{5}$ grain of cocaine. Atropine sulphate 2 grains; morphine acetate 40 grains; acetic acid 4 minims; water up to 1 ounce—twelve minims = 1 grain of morphine and $\frac{1}{20}$ grain of atropine—Talfourd Jones. Morphine is used to relieve pain (as of neuralgia, gall-stones, renal calculus, &c.), to relieve insomnia, to arrest nervous vomiting, in the treatment of diabetes, &c. It must be used with the utmost caution, and its administration should on no account be trusted to the patient. Small doses (of not more than $\frac{1}{6}$ or $\frac{1}{4}$ of a grain) should, as a general rule, be commenced with. Great care must be taken to avoid inducing the morphine habit (morphinomania).

Muscarina—Muscarine has been used by Ringer in doses of $\frac{1}{3}$ to $\frac{3}{4}$ of a grain. It may be employed in the night-sweats of phthisis, as an antagonist to atropine, and to arrest the secretion of milk. Its action is similar to that of pilocarpine, over which salt it possesses no advantages.

Nitroglycerinum — Nitroglycerine, or *Trinitrin.* Alcoholic solution of nitroglycerine (1 per cent.) 25 minims; cherry-laurel water up to 160 minims. *Dose*, 2 minims, repeated as required. Injections should be made deeply into the thighs or gluteal regions. *Used* in angina pectoris, asthma, megrim, Menière's disease, sea-sickness, puerperal convulsions, &c.

Phenazone. Doses of 2 grains and upwards dissolved in distilled water may be injected in pyrexia. The drug has also been used hypodermically in various neuralgiæ, lumbago, neuritis, megrim, and sea-sickness. It should be deeply injected.

Picrotoxinum — Picrotoxine. *Dose*, $\frac{1}{60}$ to $\frac{1}{20}$ grain. *Used* with great benefit in the night-sweats of phthisis. Administered at intervals of two to ten days. According to Gubler, useful in labio-glosso-laryngeal paralysis.

Pilocarpina—Pilocarpine, and its salts. Nitrate of pilocarpine 1 grain; distilled water 20 minims. *Dose*, 2 to 6 minims (Martindale and Westcott). *Antidote*, atropine. *Used* as a powerful diaphoretic in uræmia, asthma, puerperal convulsions, tabes spinalis, polyuria, &c.

Quinina — Quinine. The hydrobromate is the most useful salt for hypodermic purposes. Quinine hydrobromate 15 grains; distilled water 80 minims. Sixteen minims (= 3 grains) thrice daily. Tabloids containing $\frac{1}{2}$ grain may also be used. *Used* as an antipyretic in phthisis, fever, and as an antiperiodic in ague.

Solanine, Hydrochlorate of. This alkaloid belongs to the same class of poisons as eserine, pilocarpine, and atropine. The hydrochlorate is a gelatinous body readily soluble in water. The *dose* is 1 to 3 grains per diem. It has been *used* with marked benefit by Geneuil in sciatica, rheumatic neuralgia, prurigo, cystitis, and other ailments in which nervous symptoms preponderate. In children it is said to be a safe and useful substitute for morphine.

Sparteine, Sulphate of (an alkaloid obtained from the *Cytisus scoparius*). *Dose,* $\frac{1}{10}$ to $\frac{1}{2}$ grain. *Used* at first as a diuretic. Has since been strongly advocated by Dr. Oscar Jennings to overcome the morphine craving, alcoholism, &c.

Strophanthin (the active principle of *Strophanthus hispidus*). Tabloids ($=\frac{1}{500}$ grain) are the most convenient form for hypodermic use. *Used* in all forms of weak heart, in granular kidney, and other forms of Bright's disease, and in asthma due to cardiac and renal troubles.

Strychnine, and its salts. For hypodermic purposes the sulphate, nitrate, or hydrochlorate may be used. Discs ($=\frac{1}{70}$ grain) or tabloids ($=\frac{1}{100}$ and $\frac{1}{150}$ grain) are convenient. Strychnine hypodermically has also been used with great advantage in various forms of paralysis—*e.g.* of the vocal cords, in some forms of hemiplegia and paraplegia, also in urinary incontinence, tabetic pains, diphtheritic paralysis, &c. Drs. Lauder Brunton and Cash have shown that strychnine has a powerful action on the cardiac ganglia, and on the vaso-motor and respiratory centres. Hypodermic injections of the drug are of great value in feeble cardiac action, especially when due to acute pulmonary disease, in renal coma, and in threatened cardiac failure from shock or exhaustion. They are also of undoubted service in failing respiratory action due to opium poisoning. The best antidote to strychnine poisoning is chloral hydrate by mouth, or amyl nitrite hypodermically.

Urethan is useful in cases of simple insomnia and in that due to mental disease. Hypodermic injections cause trifling pain, and *doses* of from 2 to 5 grains may be given by this method.

Vaseline and other petroleum products, such as paroleine, are specially useful as vehicles for the hypodermic injection of antiseptics. Eucalyptol, turpentine, carbolic acid, iodoform, iodine, and camphor may be injected in this form without giving rise to local irritation. ANDREW S. CURRIE.

HYPOGASTRIC REGION (*ὑπό*, under; and *γαστήρ*, the belly).—The hypogastric region is conventionally described as lying between the right and left inguinal, below the umbilical, and above the pubic regions.

ANATOMICAL RELATIONS.—The *surface* of the hypogastric region in ordinary persons is flat, showing the muscular reliefs; it is rounded in children; and in some individuals, much emaciated from disease, it becomes concave.

The *median furrow* disappears below the umbilicus, owing to the approximation of the recti muscles. In women the furrow is rarely pronounced—a point of importance in ovariotomy.

The *integument* is very elastic and movable, especially at the sides.

The *superficial fascia* consists of two laminæ, between which lie the subcutaneous vessels; but in the middle line these laminæ are blended. It is strengthened at its lower part by the *triangular fascia.*

The *aponeuroses* of the external and internal oblique muscles are united in the linea alba, and form a portion of the *sheath of the rectus.*

The *recti muscles* themselves have their inferior attachments in this region, along the line extending between the spine and the symphysis of the pubes; their outer edges curve outwards, and become straight as they enter the sheaths.

The *pyramidales,* two small triangular muscles, arise from the pubes, lie in the same sheaths as the recti, and assist in closing in the abdominal parietes anteriorly and below.

Immediately beneath the recti is the *fascia transversalis,* with a little loose areolar tissue and fat, the fascia being tolerably adherent along the central line. Beneath the fascia transversalis there is a considerable amount of loose areolar tissue, between it and the *parietal peritoneum,* which in this region is very loosely attached, and reflected off the bladder on to the fascia transversalis. Enclosed in folds of the peritoneum lie, on either side, passing upwards to the umbilicus, the remains of the hypogastric arteries; and from the apex of the bladder in the middle line, passing to the umbilicus, is the obliterated urachus, which acts as the superior ligament of the bladder.

The *viscera* corresponding to the hypogastric region are—the *bladder* when full; and the *small intestine,* covered by the *great omentum.* When the bladder is full, the intestines are pushed aside, and the former then lies against the pubes and recti. In children, the bladder, being an abdominal rather than a pelvic viscus, always lies in this region. During pregnancy the *uterus* also corresponds with the hypogastric region.

The *vessels* are the deep epigastric, with the *veins* which pass obliquely inwards from the internal iliac. They lie between the peritoneum and the transversalis fascia.

The *nerves* are derived from the lower intercostals and lumbar. The *lymphatics* pass into the inguinal, superficial pubic, and lumbar glands.

Clinical Relations.—The hypogastric region is of clinical importance chiefly from an operative point of view. It is in the median furrow (usually a brown mark, which sufficiently indicates to the operator his whereabouts) of this region that the operation of tapping in ascites is usually performed; and that the principal incision is made in ovariotomy, laparotomy for intestinal obstruction, and the Cæsarian section, supra-pubic lithotomy, and the many recent abdominal explorations and operations. The bladder is occasionally tapped above the pubes. The presence of the distended bladder or of the pregnant uterus, forming a tumour in the hypogastrium, has been already referred to. Enlargements here from these causes have to be diagnosed from pelvic tumours of various kinds, which, in growing upwards into the abdomen, occasionally occupy the middle region instead of either groin. Amongst the morbid conditions of the abdominal parietes in the hypogastric region that require special mention, are abscesses connected with disease of the lumbar spine, which occasionally point above the pubes, on either side of the middle line. The pus in such a case is normally situated between the peritoneum and the fascia transversalis. The anatomical conditions bearing on the operations for internal herniæ, &c., must be most carefully considered; as a rule, the mesial line is or should be selected for abdominal exploration.

Edward Bellamy.

HYPOGLOSSAL NERVE, Disorders of.

—The hypoglossal nerve is the motor nerve for the tongue, and for most of the other muscles which are attached to the hyoid bone, the exceptions being the stylo-hyoid, the mylo-hyoid, and the middle constrictor of the pharynx. It also supplies the sterno-thyroid muscle.

1. Paralysis.—Paralysis of this nerve is shown chiefly by the resulting interference with the movement of the tongue—'glossoplegia.'

Ætiology.—The hypoglossal nerve may be damaged in any part of its course by the growth of tumours, even outside the skull; but is most commonly affected at its origin from the medulla, by pressure, meningitis, syphilitic processes, or by caries of the upper cervical vertebræ. The tongue is also paralysed by disease of the nucleus of origin of the hypoglossal fibres, but its paralysis is then associated with that of the lips, and commonly also of the palate, pharynx, and glottis (*see* Labio-Glosso-Laryngeal Paralysis). Such paralysis may be sudden, from local softening, or gradual, from nuclear degeneration. The latter form is often part of progressive muscular atrophy. Disease of the motor tract above the nucleus also causes paralysis of the tongue, together with the face, arm, and leg of the same side. The loss of voluntary power of protrusion is much greater when the paralysis is on the right side, than when on the left, but probably only when the disease is in the cortex, and aphasia is associated with the hemiplegia. Bilateral glossoplegia commonly results from disease of the nucleus or its neighbourhood, rarely from symmetrical disease of the cortex in 'pseudo-bulbar paralysis.' Unilateral paralysis, when isolated, is generally due to disease of the fibres of the nerve within or outside the medulla.

Symptoms.—In unilateral paralysis, the tongue at rest is in its normal position in the mouth, but its root is higher up on the paralysed than on the normal side, in consequence of the loss of the tonic, or voluntary, contraction of the posterior fibres of the hyo-glossus. Within the mouth, the tongue is moved freely to the healthy side, but is not moved to the paralysed side. When protruded, it deviates towards the paralysed side, because the protrusion is the result of the action of the fibres of the genio-glossus, and the tongue is pushed over towards the weaker side. In bilateral paralysis the tongue lies in the mouth behind the teeth, and cannot be protruded. If the loss of power is complete, the tongue cannot be projected over the lower teeth. It is broad and flabby, if there is no atrophy, and sometimes when atrophy is associated with fatty overgrowth. When there is wasting, as is generally the case when the nerve or nucleus is diseased, the tongue is shrunken and its surface is wrinkled, on one side or both. The faradic irritability of the muscular fibres is then lost. In unilateral paralysis, articulation and deglutition are little impaired. The pronunciation of labials and the production of falsetto notes may, however, be difficult. In bilateral paralysis, articulation is impossible. Phonation is not impaired, unless the larynx is also paralysed. Mastication is impeded, because the food cannot be moved about in the mouth. Deglutition is also interfered with, because the food cannot be rolled into the fauces; and soft foods, when they reach the pharynx, may be driven again into the mouth, in consequence of the absence of the natural supporting movement of the tongue. Taste is not primarily affected, but may be somewhat dulled, because the patient is unable to move sapid substances over the surface of the tongue.

Diagnosis.—The position of the lesion is indicated by the associations of the paralysis. If the disease is in the motor tract above the nucleus (pons, crus, or hemisphere), there is hemiplegic weakness on the side of the paralysis of the tongue. In disease of the nucleus the paralysis is commonly bilateral, is associated with paralysis of the lips and throat, and there is usually wasting. Disease of the fibres of origin within the medulla may be associated with paralysis of the opposite limbs, so that the tongue deviates from the paralysed side. When the disease is at the surface of the medulla, the paralysis is commonly associated with that of the corresponding half of the palate and vocal cord, from disease of the adjacent spinal accessory. In all these cases there is commonly wasting. The diagnosis of the pathological cause of the paralysis rests on the course of the affection, and on the presence of any causal and associated condition. The chief sources of error in diagnosis arise from the fact that in hysteria the tongue is often voluntarily but persistently protruded towards one side; the cause is recognised by the freedom of movement within the mouth. In facial paralysis, with lateral deviation of the orifice of the mouth, the tongue may be protruded, consensually, in the middle of this, and therefore to one side of the middle line of the face. A knowledge of the fact will prevent error. *See* Facial Paralysis.

Prognosis.—This is usually unfavourable, on account of the gravity of the disease which damages the nerve or centre. Even in syphilitic cases, recovery is often incomplete unless early and energetic treatment can be adopted.

Treatment.—The treatment of paralysis of the hypoglossal nerve is that of the causal disease. Tonics, counter-irritation, iodide of potassium and mercury, with the application of electricity to the tongue if there is reason to anticipate recovery of some nerve-fibres, are the most important remedies to be employed, according to the ætiological indication. The most convenient method of applying electricity is by means of a tongue depressor in a wooden handle, the blade being insulated by a coating of sealing-wax where it comes in contact with the lips.

2. **Spasm.**—Spasm in the parts supplied by the hypoglossal nerve is rare. The tongue participates in the convulsive movements in epilepsy, is jerked between the champing jaws, and thus becomes bitten. It is often the seat of tonic persistent spasm in hysteria. Cases have been met with in which the tongue is affected with a 'functional spasm' in speaking, analogous to 'writer's cramp,' but these are so rare as scarcely to need detailed description. W. R. Gowers.

HYPOSPADIAS (ὑπό, under; and σπάω, I draw, or tear).—A malformation of the penis in which the orifice of the urethra is underneath or behind the glans. *See* Penis, Diseases of.

HYPOSTASIS (ὑπό, under; and στάσις, standing, settlement).—Definition.—This term is applied to that condition of the vessels of a part which consists in an overfulness, with a diminution in the rate of flow of the contained fluid, caused rather by a failure in the propelling forces of the venous circulation than by an actual increase in the resistance ahead, as occurs in mechanical congestion. Among such causes, gravity, as exerted in the dependent position, is probably the most potent, especially when associated with lowered arterial tension.

Pathology.—The entire conditions of the venous circulation are such as to readily favour a stasis or stagnation of the blood-flow; and a trifling cause, such as would in no way affect the arterial flow, may easily impede the venous current. The veins also are, as a rule, less firmly supported by the surrounding tissues than the arteries; and this, with their thinner coats, slighter elasticity and resistance, render them easily liable to distension by the blood in congestion. If a dependent position be added to these conditions, thereby offering a resistance to the return flow of the blood, whilst it favours the circulation in the arteries, a combination of circumstances exists to which the term *hypostatic congestion* is applied. The liability of the veins of the leg to become congested, leading to a varicose condition and its results, is an example of this state. If, in addition to all these factors, the heart be enfeebled and the arterial tone be diminished, together with an impaired *vis à fronte* from weak inspiration, obviously another cause for stagnation is introduced, which of necessity will manifest itself most in those situations predisposed to stasis. Such a state is seen in the hypostatic congestion of the lungs which usually attends in a greater or less degree all pyrexial conditions, especially the typhoid state. The recumbent attitude, the enfeebled heart, and the lax vessels eminently favour an overfulness of the veins. It is obvious that, although the excess of blood primarily occurs on the venous side of the capillary system, very soon the arterial area will share in the engorgement, and the whole vascular system of the part become overfilled.

Results.—The pathological results of such a state are very much the same as those following any congestion. The distended vessels, with the increased blood-pressure that co-exists, readily permit of a transudation of the fluid part of the blood, hence œdema; if the conditions be extreme, capillary rupture may take place, and hæmorrhagic effusions result. Any continuance of this state will lead to malnutrition of the tissues affected; the proper supply of arterial blood is interfered with; and the part is loaded with an effete venous blood, and is infiltrated with serum. Hence the structural repair of the tissues is improperly performed, and there is a tendency to the development of an imperfect form of connective tissue; or, on the other hand, the destructive rather than the productive aspect may predominate, and ulceration follow. When the hypostasis is associated with an acute general state, as of the lungs in any specific febrile disease, it is very apt to pass on into a form of inflammation characterised by a want of acuteness. There are the same inflammatory products, the same changes in the vessels and tissues of the lungs, and very much the same symptoms as occur in the course of an ordinary pneumonia, but they are less severe in character, and on the whole do not tend so readily to a favourable resolution.

Treatment.—Recognising the cause, alteration of position is obviously the rational treatment of hypostatic congestion; additional support by bandaging is necessary. In acute febrile diseases cardiac stimulants are of much service in the prevention or relief of this condition in connexion with the lungs, should the heart's action be enfeebled. W. H. Allchin.

HYSTERALGIA (ὑστέρα, the womb; and ἄλγος, pain).—Pain in the womb, frequently supposed to be of a neuralgic nature. *See* Womb, Diseases of.

HYSTERIA (ὑστέρα, the womb).—Synon.: Fr. *Hystérie*; Ger. *Hysterie.*

Introduction.—'Hysteria' is a term the etymology of which is misleading, and had best, therefore be disregarded. It is often improperly applied to cases of simple malingering, and others which do not admit of ready explanation. Its use is best restricted to a condition of the nervous system fairly defined, but the intimate pathology of which is not known, characterised by the occurrence of convulsive seizures and by departures from normal function of various organs, leading to very numerous and often perplexing symptoms. These are apt to simulate those commonly arising from definite alterations of structure, but differ from the latter in the fact that they may often, even when at their worst, be removed instantaneously, usually under the influence of strong emotion. It would seem that there is a disturbed or congenitally defective condition of the cerebral substance, involving in all cases the highest nervous centres, and in various examples extending more or less also to some of those which preside over automatic phenomena. Partial or complete suspension of inhibitory influence would appear to be the most patent result of the condition, whatever it be; and this is recognised as well in regard to the mental as to the more evidently physical processes belonging to cerebral function. A laugh which cannot be checked, but continues until tears flow or the limbs become convulsed, is a typical example of such a suspension of control, and, if studied, throws light upon the nature of a considerable portion of the phenomena of hysteria. The jerking expirations of laughter arise from excitation of the respiratory centre; and when this excitation, uncontrolled by higher centres, acquires an abnormal strength, it extends to other parts of the medulla oblongata and spinal cord, and produces general convulsions. It overflows, as it were, into other nervous centres, which in health would receive none of the exciting impulse. Between the lowest (automatic) functions of the cerebro-spinal nervous system and the highest (psychical) there is an ever-increasingly complex system of excito-motor processes, which may be in part or wholly under the pathological influence, whatever it be. Hence the *bizarre* character of the hysterical phenomena, and the circumstance that the symptoms always include modifications of those processes which underlie the mental faculties. The suspension of the power of control possessed by the higher centres explains the irregular movements, spasms, and convulsions. In hysteria, hyperæsthesia and pain are probably dependent upon such a molecular change being initiated in the sensory ganglionic centres as is ordinarily propagated from the periphery. Hysterical paralysis, on the other hand, signifies that the power of the higher centres in liberating movements is in abeyance. In hysterical anæsthesia it is probably feeling or sensory perception, and not the function of the more immediate sensory apparatus, which is in abeyance, whilst the reflex actions which result from excitation of sensory nerves are performed in an orderly manner. A patient may work a needle with fingers which can be touched or pricked without the act being felt. Tactile impressions are conveyed to the ganglionic centres by the afferent nerves, and excite the action of efferent nerves so that the muscles are contracted. What is wanting is the participation of those higher centres in which consciousness runs parallel to this physiological action.

Ætiology.—*Predisposing causes.*—It is probable that a state of more or less imperfect development of the higher nervous centres, of congenital origin, very frequently underlies the various circumstances which apparently conduce to the hysterical conditions.

The female sex is much more prone than the male to the affection, which usually occurs between the ages of fifteen and thirty, and most frequently of all between fifteen and twenty. Luxury; ill-directed education, and unhappy surroundings; celibacy where not of choice, but enforced by circumstances; unfortunate marriages; alcoholism; premature cessation of ovulation; and long-continued trouble—all predispose to hysteria. A somewhat frequent antecedent is a long and wearisome nursing of a sick relation, with much broken rest. The disorder is only exceptionally found in women suffering from diseases of the genital organs, and its relation to uterine and ovarian disturbance is probably neither more nor less than that which obtains in other neuroses. Exception must be made in the case of prostitutes affected with venereal disorders, who are very prone to hysteria. In this class, however, the condition is complicated by the physical and moral influences to which their life subjects them, and amongst these alcohol frequently occupies a very important place. Like epilepsy, migraine, and some forms of insanity, hysteria is prone to be intensified at the catamenial period.

The occurrence of hysteria (although comparatively rare) in males is sufficient of itself to disprove the uterine theory of causation.

Determining causes.—These include painful impressions; long fasting; strong emotions; imitation; and shock to the nervous system, physical or moral.

Symptoms and Diagnosis.—In the limited space in which it is necessary that the subject of hysteria should be treated, it will be best to describe together some of the most frequent forms which the neurosis takes, and the principles upon which a diagnosis can be made. Hysteria produces symptoms which may be referred to every function of the body. For consideration they may be roughly classed in the following groups, it being understood that all may occur either coincidently or in succession: (1) *Mental*; (2) *Sensory*; (3) *Motor*; (4) *Circulatory*; and (5) *Visceral*.

1. *Mental.*—The intelligence may be apparently of good quality, the patient evincing sometimes remarkable quickness of apprehension; but, carefully tested, it is found to be wanting in the essentials of the highest class of mental power. The memory may be good, but judgment is weak, and the ability to concentrate the attention for any length of time upon a subject is absent. So also regard for accuracy, and the energy necessary to ensure it in any work that is undertaken, are deficient. The emotions are excited with undue readiness, and when aroused are incapable of control. Tears are occasioned not only by pathetic ideas but by ridiculous subjects, and peals of laughter may incongruously greet some tragic announcement. Or the converse may take place: the ordinary signs of emotion may be absent, and replaced by an attack of coma, convulsion, pain, or paralysis. Perhaps more constant than any other phenomena in hysteria is a pronounced desire for the sympathy and interest of others. This is evidently only one of the most characteristic qualities of femininity, uncontrolled by the action of the higher nervous centres, which in a healthy state keep it in subjection. There is very frequently not only a deficient regard for truthfulness, but a proneness to active deception and dishonesty. So common is this, that the various phases of hysteria are often assumed to be simple examples of voluntary simulation, and the title of disease refused to the condition. But it seems more reasonable to refer the symptom to impairment of the highly complex nervous processes which form the physiological side of the moral faculties.

2. *Sensory.*—Pain, hyperæsthesia, and anæsthesia occur with perhaps equal frequency. The diagnosis of the hysterical origin of such alterations of sensibility is effected partly by excluding the presence of other causes, and partly by consideration of any accompanying or antecedent peculiarities of manner and conduct. Hysterical *pain*, where it is associated with some evident local change, is found to be greatly in excess of that which would ordinarily accompany the observed cause. Where pain or hyperæsthesia is complained of in situations and of a character which would commonly point to some existing inflammation, it is necessary, by examination of the pulse and temperature, to exclude such a condition. Hysterical pain is apt to cease suddenly when the attention is diverted, and to be increased by inquiry and sympathy. Some of the most common seats of pain and tenderness are the following:—

(*a*) The lower part of the side of the chest (usually the left) simulating intercostal neuralgia, but distinguished from it by the tenderness being widespread, superficial, and not confined to certain points. Pressure here will sometimes occasion disturbances of respiration and circulation.

(*b*) Some of the vertebral spines, usually in the cervical and upper dorsal region. From the error of mistaking this for commencing disease of the vertebræ numbers of young women have been confined to a couch for months or years, and their health permanently damaged. The points of diagnosis are the patient's antecedents: there is often a history of aphonia, or paralysis, or hysterical fits. Or it may happen that, long after the pain has been first complained of, the patient has been seen to take a prodigious amount of exercise *on some one occasion* without complaint. A very much slighter pressure, too, causes pain than is at all usual in vertebral caries. It has to be remembered, however, that a patient affected with vertebral disease may also be hysterical.

(*c*) Acute pain in a joint, occurring usually some little time after a slight injury and giving rise to suspicion of inflammation, but distinguished from this by the fact that after a few days of great pain the joint does not feel hot to the touch, and is not swollen, and that the thermometer shows no rise of temperature. The pain is more easily excited, too, by touching the skin than by pressing the articulatory surfaces against each other.

It is necessary to remember that in locomotor ataxy there may be exquisite pains (of a shooting character) having their seat in a joint or its neighbourhood, and accompanied by some localised hyperæsthesia of the skin. The disease rarely affects young females, but it may do so, and the condition is then extremely liable to be mistaken for hysteria. The chief points of diagnosis are, that in locomotor ataxy there will usually be—(1) absence of patellar tendon reflex; (2) a peculiar character of the pains—lightning-like; (3) probably some analgesia of the extremities; and (4) an ataxic gait. *See* TABES DORSALIS.

(*d*) Tenderness of the mamma or darting pains through its substance, recalling those of scirrhus. The absence of any lump, and the effect of engaging attention, will serve to insure the distinction.

(*e*) Pain in the head of very severe character, 'like a nail being driven into the skull' (*clavus*). This is probably neuralgic, and is by no means confined to the hysterical. There is also a more diffused pain, described as of great violence and exceedingly obstinate. This pain is sometimes suggestive of cerebral tumour, from which, however, it may often be distinguished by the fact that the ophthalmoscope shows no optic neuritis, and that there is no vomiting. But great caution is necessary in coming to a conclusion that severe and long-continued pain in the head is hysterical. And here it may be well to say that in an accurate knowledge of the characteristics of the disease supposed to be simulated lies the only safety as regards the diagnosis of hysteria. Nor must it be forgotten that persons with serious organic disease are frequently affected also with hysterical symptoms.

(*f*) Epigastric tenderness. Careful pressure will often show that the tenderness is at the origin of the recti abdominis muscles, and not in the stomach. But there is sometimes pain in the stomach itself, and this may be associated with disgust for food or depraved appetite.

(*g*) Tenderness in one or other iliac region, deep pressure upon which will sometimes evolve hysterical symptoms, and also in some cases of hysterical convulsions will check the paroxysm.

Anæsthesia may involve (though rarely) the whole body. It is more commonly confined to one half, and this the left, and is then frequently associated with tenderness in the iliac region of the same side; or it may be limited to a small patch. The sense of touch often remains whilst painful impressions and those of temperature cannot be perceived. The anæsthesia may be confined to the surface, or involve as well the deeper structures, into which pins may be stuck without evoking signs of pain. The left conjunctiva is often the seat of anæsthesia, so that it may be touched or even rubbed without any reflex movements of the eyelids being excited. So also the pharynx may be tickled without exciting the ordinary spasmodic contraction, and the epiglottis touched by the finger without inconvenience. A very frequent symptom is loss of reflex contraction when the sole of the foot is tickled with a feather. This is sometimes complete; in other cases prolonged titillation will evoke a plantar reflex of greater or less extent. Such affections of cutaneous sensibility or of reflex action may have to be looked for, as they are often unsuspected by the patient herself. As regards diagnosis, the existence of peripheral nerve-lesions may be excluded by the absence of trophic disturbance. The condition is not likely to be confounded with hemiplegia, unless perhaps when it has immediately followed a convulsive attack, and is accompanied by apparent loss of power in the limbs. Examination of the patient and her history will suffice for the diagnosis.

The other special senses also may be disordered in hysteria. There may be intolerance of light, subjective sense of taste or smell, roaring noises in the ears; or, conversely, loss of sight (either in half of both eyes, or in one eye), loss of smell, or taste, or hearing. Or there may be feelings as of a limb or other part being enormously enlarged, of the body being confined in a stiff case, of the feet being drawn up by strings under them, of 'pins and needles' around the waist, or of numbness and coldness in one half of the body (almost always the left). It may be said generally of the disorders of sensation that they are capricious in their appearance, coming and going as they would not did they depend upon organic disease (this recurrence is especially significant); that they are very apt to ensue upon some moral shock or convulsive seizure; and that careful examination will prove them to be unaccompanied by such other symptoms as would be likely to be present did they depend upon the organic alteration which they simulate.

3. *Motor.*—The principal motor symptoms in hysteria are local spasm, more or less general convulsion, and paralysis. A common symptom of hysteria is the *globus hystericus.* A lump appears to the patient to arise from the epigastrium like an egg, and, travelling upwards to the throat, causes a sensation of choking, and is often accompanied by an outburst of tears.

Spasm affecting some out of the various muscles concerned in the respiratory acts gives rise to a great variety of symptoms highly characteristic of hysteria. There may be cough of a peculiarly sharp, ringing character, constant except during sleep, unaccompanied by expectoration, strongly influenced by moral causes. A little observation will show that the cough does not occur when the patient is quite alone and apparently no one within earshot; but, on the other hand, is greatly intensified by inquiry and solicitude. It ceases during sleep. Sometimes, instead of cough, a loud expiratory sound is produced, of most discordant character, resembling, perhaps, a railway whistle, the quacking of a duck, or the barking of a dog; and this may take place irregularly, or may be marked by a curiously distinct periodicity. Or there may be rapid, deep whooping inspirations, with signs of suffocation. Occasionally with the hysterical cough there is a hypersecretion of mucus; and if, as often happens, there is also disturbance of digestive functions and consequent tendency to emaciation, and at the same time such constriction of the air-passages as gives rise to sibilant *râles*, a *primâ facie* resemblance to phthisis is presented, which can only be distinguished by prolonged observation, aided by the stethoscope and thermometer. Laughing and crying are very frequent forms of expiratory spasm. Yawning, hiccough, and sneezing are also met with. *Clonic spasm* of muscles, especially of those moving the head and shoulders, or back, is not uncommon. Or one of the muscles of the thigh may be so affected, and the apparent pulsation caused by the rhythmical contractions give rise to a suspicion of aneurysm.

Tonic spasm of one or more muscles of a limb is still more frequent. It is often very obstinate, and after enduring for months or years may suddenly resolve without any permanent alteration being left behind.

Contracture of a limb thus produced may continue during sleep, and even resist the influence of chloroform inhalation, unless this is pushed to its full extent. Should one of the abdominal muscles be thus affected, an abdominal tumour is produced, which may be mistaken for some growth in the cavity; and if the pulsations of the aorta should be communicated to it, a strong *primâ facie* resemblance to abdominal aneurysm is caused. The best mode of diagnosis is by faradisation, which, if persevered in for several minutes, will exhaust the muscular contractility and cure the ailment if it be of this kind. If it is not a 'phantom tumour' of this description, but a genuine growth, the muscle will be contracted by the current, and it may then be possible to feel the tumour as something evidently distinct from the muscle.

Convulsive seizures are of common occurrence, and are usually preceded by a sense of suffocation, difficulty of swallowing, pain in the belly or stomach, headache, vertigo, or some indescribable sensation in one of the extremities. There is often a cry as of one being choked, unlike the peculiar wailing shriek which ushers in the epileptic seizure. Usually there is not the extreme suddenness of attack which characterises epilepsy, but the patient may be manifestly struggling against the seizure for a small but appreciable interval. When at last she falls, she does not usually do so with violence enough to receive severe injury, and positions of danger are generally avoided. The epileptic often falls in the fire, the hysterical patient never. The spasms of muscles which succeed are often tetanic in character, and sometimes wear an aspect of design — the patient grips articles with her hands or teeth. The face may be more or less red. In epilepsy it is usually first pale and then livid.

There is often more or less complete opisthotonos, which is usually absent in epilepsy. It has been doubted whether consciousness is ever completely lost in an hysterical fit; but though for the most part perhaps it is retained during the attack, there are certainly cases in which it is to a great extent in abeyance. It is characteristic of hysteria that, however rapid and violent the contortions, the patient usually avoids inflicting any serious injury upon herself. During the attack gesticulations and language are apt to be used which may be reproachful, or marked by an amatory character as regards some bystander, such as is calculated to cause him considerable embarrassment. There may be a single convulsive seizure, terminated by a fit of weeping and the passage of a large quantity of almost colourless urine of low specific gravity. Or there may be a succession of attacks extending sometimes over several hours. The tongue is not bitten. As a rule, the hysterical patient rapidly returns to her ordinary condition after the outburst is completed, and fails to show the heaviness and tendency to sleep which is characteristic of epilepsy. The variety seen in the character of hysterical convulsions suggests that the pathological influence involves the nervous centres, sometimes more and sometimes less extensively; giving rise to various kinds and degrees of muscular movements, from those of a highly co-ordinated or quasi-voluntary kind, down to those of a simply tetanic form. These latter would appear to indicate either that control of the reflex function of the spinal cord is temporarily suspended, or that the cerebellar influence, as Dr. Hughlings Jackson thinks, is being allowed to have full play, owing to some peculiar condition of the cerebrum interfering for a time with its normal power of antagonism. But it must be borne in mind that the hysterical patient may, like others, become epileptic, and that there is nothing on the other hand to prevent the chronic epileptic from betraying occasionally symptoms of hysteria. Such mixed cases are often difficult of diagnosis, and it is usually only a prolonged observation which succeeds in distinguishing the nature of the condition. Movements which somewhat resemble those of chorea are occasionally met with, but their character and the surrounding circumstances usually make it easy to distinguish them.

Paralysis may affect any of the limbs in hysteria, but paraplegia is the more usual form. Hemiplegia is comparatively rare. The muscles retain their nutrition. There is often at first a slight loss of irritability to induced currents, but after a very few applications this becomes normal. At first, too, considerable electro-cutaneous and electro-muscular insensibility may be present. If the form of paralysis be hemiplegic, the mouth is not affected; if paraplegic, the sphincters are not paralysed, and although incontinence of urine sometimes occurs, there is no cystitis, and the urine does not become ammoniacal. There is never any bedsore. If the arm be the limb affected, and the examiner, after flexing it slightly, leaves go, it will sometimes remain in the flexed position, which it would not do in hemiplegia. It is noteworthy that, in half the cases of hysterical paralysis, there is no history of antecedent convulsions. Cutaneous anæsthesia of the extremities will give rise sometimes to a pseudo-paralysis, and muscular anæsthesia may cause symptoms of ataxy. These may be distinguished from the result of organic change by careful examination. Hysterical speechlessness may be distinguished from aphasia by the patient being able to write down with great facility the wishes she is unable to express in speech; and from localised paralysis of the tongue, by her being perfectly able to protrude the organ and to swallow.

4. *Circulatory.*—There may be syncope which will simulate dying. After an indescribable sensation at the heart—a fulness or stifling feeling—the pulse becomes almost imperceptible, the patient is speechless, and, for periods varying in length, is apparently in a most precarious condition, recovery taking place after prolonged sighing. Or there may be tumultuous action of the heart. The abdominal aorta (and sometimes also other arteries) is occasionally the seat of powerful pulsations, which are visible in their effects upon the abdominal wall and strongly suggest the existence of aneurysm. The capillary circulation may be deranged in the two directions of hyperæmia and ischæmia. In the former there is a patch of redness of the skin, accompanied by a feeling of burning and tenderness; in the latter, which is especially seen in conjunction with analgesia, the skin is pale and no bleeding follows the pricks of a pin. In a recorded case, pressure upon a tender spinous process checked the radial pulse for a time.

5. *Visceral.*—Vomiting is sometimes a very obstinate symptom, all food taken being speedily ejected, the condition lasting a surprisingly long time, often for many months, sometimes for years, usually without so much prostration as might be expected, but nevertheless with great loss of weight. Or there may be such an active aversion from food as renders it very difficult to support nutrition; or a depraved appetite may cause substances to be swallowed which have no nutritious property. In the belly there is frequently a hyper-secretion of gas with spasm of the bowels, causing borborygmi and noisy eructations. Intestinal gas may be imprisoned between two points of spasmodic contraction of the intestine, giving origin to a tumour capable of being moved about in the abdominal cavity, and of sudden resolution. These 'balloons,' as they have been called, are probably sometimes mistaken for tumours of the spleen, kidney, or other organ. It is not uncommon to have retention of urine, the bladder becoming greatly distended, but contracting at once and expelling its contents if the patient be placed in a hip-bath, and a bucket of cold water thrown over the pelvis. In other cases there is an unduly frequent desire to empty the bladder, and there may be some incontinence. The secretion of urine may be suppressed almost entirely (but this is very rare), the little urine that is passed containing an unusual proportion of urea, which is also found in the vomiting accompanying this condition.

There is sometimes very obstinate constipation, extending over weeks or even months, and giving rise to enormous impaction of fæces—occasionally also diarrhœa.

Cases occur in which the symptoms of cerebro-spinal sclerosis of the disseminated form, after persisting perhaps for many months in a young woman, rapidly or even suddenly disappear. This circumstance is often supposed to show that the case was one of hysteria. It is probable, however, that the view still generally held that the shifting of loss of power from one limb to another is really characteristic of hysteria is quite an error. The hysterical woman who has lost all power in her legs will, it is true, very often later on (whilst still paraplegic) lose the power of one arm (usually the left), but in the writer's experience she is not prone to lose the power in a limb, then recover it, and then lose it in another. The idea of this shifting of powerlessness being strongly suggestive of hysteria has probably arisen from the mistakes in diagnosing as hysteria cases of disseminated sclerosis, which must have been continually occurring before the latter disease had been differentiated. So in regard to vision. The hysterical patient will become quite blind of one eye, whilst the patient affected with disseminated sclerosis will only describe more or less obscurity of vision. The writer cannot call to mind, since he has been better acquainted with disseminated sclerosis, any case of simple hysteria in which first one eye lost some amount of vision for a time, and recovered, and afterwards the other eye behaved in a similar fashion. This is not at all uncommon in the course of disseminated sclerosis. The marked and almost constant occurrence of hysterical symptoms in the earlier stages of disseminated sclerosis often tends to obscure the diagnosis, and a very guarded prognosis becomes necessary.

It is common to class such cases with those of hysterical paralysis; but it is probable that they are examples of disseminated sclerosis recovering only for a time, as is characteristic of the disease. There is good reason to think that cases of disseminated cerebro-spinal sclerosis are not at all infrequently supposed to be simple examples of hysteria. The disease is characterised in its early stage (the only period when a mistake is possible) by some general weakness of limbs, accompanied by slight tremors on voluntary movement only, and an utterance which is slow and drawling, with occasional slurring of words. Careful examination, especially noting the circumstance that, for example, the arm only shakes when the patient is directed to take hold of an object, is usually sufficient to distinguish the disease from hysteria, but there is sometimes considerable difficulty, and great caution should be observed in avoiding hasty conclusions.

Sequelæ.—Hysterical symptoms sometimes pass into those of mania, melancholia, and occasionally also of dementia.

Prognosis.—This is favourable as regards life, death from hysteria being very rare. Recovery for a time is common enough, but too often there is a return of the disease, the symptoms being usually of a different kind. Some patients will run through almost every conceivable phase of the disorder in turn. As a rule there is a tendency to cessation of the disease after the climacteric period. It occasionally happens, however, that the disease is continued into an advanced period of life.

Treatment.—If Medicine were in a position to regulate the mode of life, food, education, and especially the selections for propagation of the species, it is probable that in succeeding generations hysteria would become more and more rare in the race. In many cases it can do but little for the individual. Intercurrent maladies must of course receive the treatment proper to them. Where anæmia is present, much good may often be done by iron. States of malnutrition tend to precipitate and intensify hysterical symptoms; and to remedy these is often to do much for the concomitant nervous disorder.

But probably the greatest amount of benefit which can be brought to bear upon the hysterical patient is through her surroundings. A girl who has not spoken above a whisper for months whilst at home, will often recover her natural tone of voice in a week if placed under the judicious discipline of strangers. This is a well-known circumstance, and the fact has tended very much to the belief that hysteria is simply vicious simulation. Such an inference is unjust.

That an altered relation of the ganglionic nerve-cells to the blood-supply forms at least a part of the pathology of hysteria appears probable from the effects of fasting in provoking hysterical outbursts, and the influence of food and stimulants in postponing them. Ammonia inhaled by the nostrils is a well-known and valuable agent for the purpose. Alcohol should be avoided altogether, as there is great danger of excess.

It is through the sensory nerves that the most rapid influence is brought to bear upon the hysterical condition. Thus cutaneous anæsthesia and hyperæsthesia may often be rapidly cured by the application of strong induced currents to the affected portion of skin; aphonia by acting in a similar way upon the skin covering the larnyx. Paralysis of the limbs is in many cases quickly cured by the same means.

Hysterical convulsions may almost always be cut short by douching the patient very freely indeed with cold water. This should be poured from a height upon the face. For a few seconds there is no perceptible effect, then the breathing becomes gasping, and the patient seeks by moving away to avoid any further application. It often happens that the remembrance of this treatment serves to prevent a repetition of convulsions, but it would be wrong to conclude from this that the proceedings of the patient had been voluntary. The effect of the cold douche is to create, through the medium of the cutaneous nerves, a sudden change in the character of the blood-circulation, which may well influence the state of the ganglionic nerve-centres. The supposition seems fair that to remember the shock is to have a weak excitement of the nerve-centres which were strongly excited by the application.

Bromide of potassium, which is of such value in the *grand mal* of epilepsy, has no influence in preventing hysterical convulsions. In a doubtful case the exhibition of this drug is therefore useful for purposes of diagnosis. Valerian (the powder or tincture) has an unquestionable effect in the convulsive and spasmodic symptoms of hysteria, little or none probably upon the paralytic phases. Asafœtida by enema is useful in tympanites and colic of hysterical origin. Small doses of strychnine and opium are useful in relieving some of the distressing feelings complained of by hysterical patients.

Dr. Weir Mitchell, of Philadelphia, has introduced a mode of systematic treatment of hysteria and nerve prostration, which has lent important aid to our means of dealing with cases of this kind. Its introduction into this country we owe to Dr. Playfair. The treatment essentially consists in the complete isolation of the patient, who lies in bed and is fed and attended by an intelligent nurse. Under the influence of massage of the muscles of the trunk and extremities, conducted twice a day for an hour or more, the patient becomes able to take large quantities of milk (from 60 to 100 oz. in twenty-four hours), besides three full meals of highly nutritious food. By these means the nutrition of the body undergoes a remarkable improvement, one or two stone of weight being often added; the muscles become firm, the skin soft and elastic; the complexion assumes the hue of health; the patient regains natural sleep if this has been lost; whilst various morbid symptoms—pains, local tenderness, contracture, loss of power in the limbs—disappear. It is especially in cases where signs of emaciation have been present that this mode of treatment achieves extraordinary success.

It is often a question whether the hysterical should marry. Where the disorder is slight and the general health is good, marriage may be advised, supposing that the prospects of a happy union are favourable. But in very severe cases, and especially when there is also a strong neurotic history in the family, it should be discountenanced. Nothing but harm can be expected from the strain of domestic cares upon a congenitally defective nervous system.

T. Buzzard.

HYSTERICAL INSANITY.—Almost every variety of insanity may present in certain patients features which are commonly known and termed 'hysterical.' Melancholic individuals will be afflicted with hysterical paraplegia or other paralyses. Some will become cataleptic or apparently unconscious. Others will display all the phenomena of hystero-epilepsy. Not infrequently do we see a violent outburst of acute mania culminating and subsiding in a brief period of time, resembling in this an ordinary attack of 'hysterics.' It may be doubtful, however, whether hysterical insanity should be looked upon as a special variety of the malady. It seems more correct to look upon it as insanity occurring in hysterical patients, and characterised by the phenomena peculiar to them. We may expect sudden changes of symptoms, sudden improvements, and sudden relapses.

Prognosis.—The prognosis is unfavourable, as this form of insanity is found in patients of an unstable nervous organisation, prone to frequent derangement. Even if recovery takes place, attacks are not unlikely to occur subsequently.

Treatment.—Such persons above all others require moral treatment. Medical treatment should be directed towards the improvement of the general health rather than the removal of special symptoms.

G. F. Blandford.

HYSTERITIS (ὑστέρα, the womb).—Inflammation of the womb. *See* Womb, Diseases of.

HYSTERO-EPILEPSY. — Synon.: Fr. *Hystéro-Épilepsie*; *Hystérie Épileptiforme*; Ger. *Hysteroepilepsie.*

Definition.—A term applied to a form of hysteria of unusual gravity, the convulsions in their violence recalling those of epilepsy, and characterised by the occurrence of remarkable forms of anæsthesia, paralysis, and contracture of muscles.

Ætiology.—The condition is one which must be classed with hysteria, and not with epilepsy, and the circumstances which tend to the production of the former disease are here equally potent. *See* Hysteria.

Symptoms and Diagnosis.—It is to the French school, and especially to Professor Charcot of Paris, that we owe the most important descriptions of this disease, which would appear to be more common on the Continent than in England. The symptoms may be divided into:—(1) *motor*; and (2) *sensory*.

1. *Motor.*—Convulsive seizures occur, preceded by an hysterical aura (abdominal or epigastric), which usually gives the patient timely warning enough to enable her to place herself in a position of safety. Then there is a shriek, the face is pallid, and she falls (perhaps whilst endeavouring to quit the room), the features become distorted, and the limbs pass into a state of tonic rigidity. There is foaming at the mouth, sometimes the tongue is bitten, and there may be some clonic convulsions with lividity of features. Relaxation of the muscles and a more or less comatose condition succeed, to be followed shortly, however, by contortions and gesticulations of a violent character, coarsely suggestive of the influence of various passions—wrath, fear, disgust, lust. Or there may be meaningless writhings, presenting a hideous aspect. To this phase sometimes succeeds hallucination of vision, or of hearing. Rats and serpents and other objects of horror are seen. The attack ends with sobs or hysterical laughter. There may remain a temporary inability to empty the bladder or to swallow food.

Convulsive seizures of this co-ordinated or purposive character, although much more common in the female than the male sex, are by no means confined to the former. The condition is not infrequently observed in boys; less often in men. In the latter there is usually the history of some great moral shock antecedent to the first outbreak.

In patients liable to attacks such as have been described, it is not uncommon to find a *contracture* of one or more limbs. This may assume the *hemiplegic* or *paraplegic* form; and it may be of a passing character lasting a few days only, or enduring for many years. The attitude may be either that of rigid flexion or extension; and it is found to remain during sleep, only relaxing under the profound effect of chloroform narcosis. The limb so affected does not suffer in its nutrition, and the reaction of the muscles to electrical currents remains normal.

The contractures, as well as the sensory disturbances described below, may be said to be practically confined to patients of the female sex. It is very rare indeed to find them in males.

2. *Sensory.*—It has been noted that in female patients thus affected (as indeed is common in hysteria generally) there is apt to be a pain in one or other iliac region, most often the left, which is sometimes constant, and in other cases is only discovered by pressure. The seat of this pain is thought to be the ovary, and it is found that whilst a moderate pressure in this region may determine the production of the aura and sometimes of an hysterical attack, energetic compression at the spot will very often cut short the convulsive seizure.

Anæsthesia and *analgesia* are apt to be found sometimes in both sides, but much more frequently in one half of the patient's body, parted off from the other by the median line, and thus involving apparently half the head, face, and trunk, as well as the upper and lower extremities, though it may be in different degrees of intensity. It not seldom happens that the patient is herself unaware of the existence of this insensibility until examination has disclosed it. The loss of sensibility sometimes affects also the special senses; and smell, taste, hearing, sight, and the perception of colour, may each or all be lost on one side.

Accompanying the analgesia it is often seen that the pin-prick employed to test the condition fails to draw blood on the affected side, whilst readily doing so in the opposite limb.

Where there is loss of power of the limbs with contracture and anæsthesia following a convulsive seizure, it is not difficult for the condition to be ascribed to an attack of hemiplegia, resulting from organic disease, and there is sometimes a doubt on this matter which is not easily resolved. The points of most value in making a differential diagnosis are the following:—(*a*) The absence *from the first* of any deviation of the tongue or facial paralysis. After a time, no doubt, in some cases of hemiplegia of organic origin these symptoms become scarcely visible, but it may be said that practically at the onset they are always present to a greater or less extent. (*b*) The extent and completeness of the analgesia, especially the mode in which it affects the trunk, which ordinarily escapes in hemiplegia. Such complete anæsthesia as occurs in these cases is rarely observed in hemiplegia of cerebral origin. In spinal hemiplegia, again, it would occupy, as Brown-Séquard has pointed out, the side of the body *opposite* to that affected with motor paralysis. Besides these there is rarely much difficulty in finding in the symptoms, surroundings, or history of the patient, circumstances which, combined with those described, throw a strong light on the nature of the condition. The hysterical patient may present, for example, retention of urine, ovarian tenderness, and tympanites; and in her history there may be an account of aphonia, convulsive seizures occurring under emotion, hysterical cough, or some other feature which tends to stamp the case as one belonging to this great neurosis.

Occasionally these contractures remain permanent. Much more frequently they relax, after a longer or shorter period, and the relaxation almost always takes place suddenly, usually under the influence of some moral shock.

It will sometimes happen that paresis and contracture of a limb will occur without any previous history of hysterical symptoms, and the possibility of this must always be borne in mind. Where there is during many hours a long-continued succession of fits with brief intervals of immunity, considerable doubt may arise as to the nature of the attacks, because a very similar, numerous, and rapid recurrence of fits sometimes takes place in true epilepsy. We are indebted to Charcot for the observation that whilst in the case of the epileptic seizures of this kind the temperature is observed to rise greatly (attaining, for instance, a height of 105° F.), no such great increase is noted when the fits are of hysterical origin—a slight elevation only occurring.

In cases of hystero-epilepsy it has been noted that there is often colour-blindness, affecting the eye on the same side as the hemianæsthesia—the order of disappearance, in most cases, being the following: violet, green, red, orange, yellow, blue. Violet is the colour most easily lost, red and blue, according to Charcot, being those which persist most, except in those cases where achromatopsia is absolute—that is, where the patient looking at a painting sees nothing but black and white.

Remarkable results have been known to follow the application of metallic plates and the approach of a powerful magnet to the anæsthetic side of the body. It is found that, if a small plate of some metal be applied for a few minutes to the skin, a return of sensibility occurs, touches and pricks previously unperceived are felt, and colour-vision is restored in the affected eye. The particular metal which will effect this change has to be sought by experiment: in one person gold, in another silver, in others again iron, tin, or copper, alone producing the effect. So again it is stated that the approach (without actual contact) of a powerful horseshoe magnet will produce a similar effect to the contact of a metal. In either case, *pari passu* with the return of sensibility on the affected side, it is noted that the other half of the body acquires the anæsthetic state. There is a transference apparently of the phenomena. The approach of a magnet, it is also found, will cause a contracture to relax, the relaxation lasting for many hours. But in this case, again, the corresponding limb of the previously normal side is found to present evidence of paresis. In two instances Rosenthal and the writer have found defective electrical excitability, as tested by sudden interruption of a strong voltaic current, in the cerebral hemisphere opposite to the side which is marked by anæsthetic symptoms. In the writer's own case the experiment was followed by considerable improvement in the cutaneous sensibility.

Treatment.—Cases of hystero-epilepsy are not amenable to any treatment by drugs. Powerful moral impressions, especially energy and commanding influence in the medical attendant, are more potent than anything else in bringing about recovery, but it is not always that these can be brought to bear. It is desirable, therefore, that in suitable cases the influence of the measures just described should be tested. In cases of convulsion strong pressure should be made upon that ovarian region in which tenderness is discovered. In examples of contracture and hemianæsthesia an application of metallic plates of various kinds may well be made to the skin of the affected side.

Very useful effects are often produced by the application of strong faradic currents, which may require to be persisted in ere any influence is produced. Blisters also, repeated every three or four days, are occasionally very useful in causing the relaxation of a contractured limb and the return of sensibility to an anæsthetic skin.

Removal of the patient from the family circle and the society of frightened or sympathising friends, is in most cases a *sine quâ non* of successful treatment.

T. Buzzard.

I

ICE, Therapeutics of.—*See* Cold, Therapeutics of.

ICHORRHÆMIA (*ἰχώρ*, puriform matter; and *αἷμα*, the blood).—A morbid condition of the blood, caused by the absorption of septic materials. *See* Pyæmia; and Septicæmia.

ICHTHYOSIS (*ἰχθύα*, a fish-scale). Synon.: Fish-skin Disease; Fr. *Ichthyose*; Ger. *Fischschuppenausschlag*.

Definition.—A disease which has obtained its name from the division of the cuticle into polygonal plates somewhat like the scales of the fish, although no overlapping exists. The skin is dry, rigid, rough, and greyish-green, often of the hue of the upper surface of the turbot; and the cuticle exfoliates, in some places as dust, in others as thin shining laminæ like mica or bran.

Ætiology.—Ichthyosis may be regarded as a defect of development of the skin, usually, however, appearing some months after birth. In rare instances it has arisen in adults. Males are affected twenty times as often as females. Heredity sometimes obtains. The degree of its manifestation may depend on various circumstances, especially those relating to scanty food and want of cleanliness. It may be regarded as endemic in the Molucca Islands.

Anatomical Characters.—The cuticle is abnormally copious; the fibrous tissue of the derma is condensed; the papillæ are enlarged and lengthened, and are sometimes apt to bleed on slight injury; the areolar layer is lax and fatless, and the whole integument wants succulence and elasticity. Further, the cuticle is hard and brittle, the inorganic matter being increased fourfold, and it cracks along the lines of motion or wrinkles of the skin; the fragments being powdery upon the neck, front of the trunk, and flexures of the joints, angular and prominent on their extensor aspects, and smooth and polyhedral on the rest of the limbs. The follicles are filled with dry epithelium and sebum, which in other places may concrete and add to the thickness of the crust. The skin as a whole forms coarse wrinkles, and from the laxness of the subcutaneous areolar tissue it moves freely over the fascia. The oily, and sometimes the aqueous, secretions are scanty, an unpleasant odour is often exhaled, and the transparency and lustre of the healthy skin are wanting. The health is usually good, but cardiac hypertrophy has been noted. The cold of winter is felt severely, and death often results from pulmonary complaints.

Modifications.—Ichthyosis varies according to site. On the limbs it is most symmetrical, and the scales are largest; on the hands and feet the cuticle is horny, and there are deep wrinkles; and on the face the detached edges of the plates cause great roughness, and the complexion is altered to a brick-red. Varieties are also produced by the amount of sebum, which may form either thick scales or projecting spines. Such modified forms have suggested several synonyms. Thus, when dryness of the skin is conspicuous it has been termed *xeroderma.* When the network of lines bounding the scales is regular and widely stretched, from the tightness of the whole integument, the name 'harlequin skin' has been applied, such instances being usually congenital and the birth premature. When the smooth surface has a mother-of-pearl polish it has been called *ichthyosis nacrea.* When the concreted epidermic and sebaceous substances resemble the scales of reptiles, the term *ichthyosis serpentina* is applied, although the monitor is the reptile whose skin it is most like; and, finally, the variety in which long spines appear is designated *ichthyosis hystrix*, the 'porcupine disease.' Malformations of the eyelids, ears, and fingers have been frequently found in ichthyotic subjects. The disease has been known to disappear after eruptive fevers.

TREATMENT.—The principles of treatment are as follows: First, we must promote an improved nutrition of the body by the use of a generous diet, cod-liver oil, arsenic, iron, or other tonics. Secondly, it is necessary to remove the excess of epidermic matter and sordes, which is best effected, when the disease is limited, by resorcin or solutions of salicylic acid; when it is extensive, by ablutions with soft water and soft soap, and especially by the Turkish bath and shampooing. Thirdly, we have to stimulate the circulation and innervation of the skin by friction and inunction with such substances as lanolin, cod-liver oil, or cacao-butter mixed with glycerine. The salve mulls and super-fatted soaps, as used by Unna, give great relief in localised cases. Injection of pilocarpine has been used to increase sweating and thus soften the cuticle.

ERASMUS WILSON. E. D. MAPOTHER.

ICTERUS (ἴκτις, a weasel; with yellow eyes).—A synonym for jaundice. *See* JAUNDICE.

ICTUS SOLIS (*ictus*, a stroke; *sol*, the sun).—A synonym for sunstroke. *See* SUNSTROKE.

IDAHO HOT SPRINGS, in Clear Creek County, Colorado, U.S.A.—Thermal waters. *See* MINERAL WATERS.

IDIOCY (ἰδιώτης, a person private or apart).—SYNON.: Feeble-mindedness; Fr. *Démence Innée*; *Idiotisme*; Ger. *Die Spracheigenheit*; *Blödsinn.*

DEFINITION.—Mental deficiency occurring during infancy or the early periods of life.

The term *idiocy* is not a scientific one, but it is convenient to employ it here to include a class of maladies which differ essentially from insanity, both as to their nature and treatment. The strict meaning of the word idiot is, 'a solitary one,' but it has become so much used as a term of opprobrium that it were well if the phrase, 'feeble-minded,' could take its place.

DESCRIPTION.—The term 'idiocy' covers such a large area, and includes such a great variety of cases, that there is endless gradation in its manifestations, from slight departure from a normal condition, to that state of profound idiocy in which the unfortunate subject thereof sees nothing, feels nothing, does nothing, and knows nothing. The typical condition, however, is best illustrated by reference to an average state. For the most part, the lesion is not only a psychical one, but profoundly affects the physical, and frequently the moral life. The stature is less than normal, and there is a tendency to assume a stooping posture. The skin is often coarse, deficient in elasticity, and lax, with increased development of areolar tissue. The muscles are weak and flabby, and respond feebly and irregularly to the action of the will. The bones are often yielding and deformed. The circulatory system is usually weak, rendering the patient liable to destructive chilblains and frostbite, inducing perilous effects from exposure to a low temperature, and rendering slow any reparative process. The lungs are extremely liable to inflammatory attacks, both in their bronchial tubes and parenchyma, and prone to tubercular disease if the subject be resident on a clay soil. The digestive system is liable to be deranged by defective mastication of food, and alternately subject on the one hand to constipation from defective innervation, and on the other hand to diarrhœa from catarrh, resulting from alternations of temperature. The sexual functions are often abnormal; there is a tendency to masturbation very early in life, while puberty itself is generally delayed, and often sterility exists. There is not infrequently phimosis and undescended testis in the male, and non-development of the ovary in the female. The motor functions are also abnormal; there is usually defective co-ordination, resulting in a deficiency in purposive acts, while there is a tendency to the production of purely rhythmical and automatic movements. There is diminished sensibility, so that what is painful to others is borne with complacency. Speech is defective, partly from want of co-ordination of the muscles of the tongue, partly owing to malformations of the mouth and palate, and partly to inability to convert ideas into words. The sight is often impaired, due to hypermetropia, to imperfect retinal sensibility, to congenital cataract, or to diminished accommodation. These conditions are frequently associated with strabismus or nystagmus. The sense of smell is lessened, and the discrimination of odours almost *nil.* The sense of taste is also defective, leading to the eating of things of an unpalatable and even repulsive nature. The faculty of hearing is not much interfered with, except in cases where there has been destructive disease of the ear. The faculties of observation and attention are limited. There is generally great fondness for music, and simple airs are often readily learned. The memory is generally good, and there are often instances of remarkable power in this respect. There is very little imagination or ability for abstract thought, while judgment and reasoning power are almost entirely absent.

Classification.—The best classification of idiocy, the one which most assists in the prognosis and treatment, is that which is based on its ætiology. The whole of the cases may be divided into three important groups, which groups afterwards admit of subdivision. The primary groups are:—(1) *congenital*; (2) *developmental*; and (3) *accidental*.

1. *Congenital idiocy.*—This includes all those cases which at the period of birth manifest signs of defective mental power, associated usually with conditions of the head, skin, and other organs, which are indicative of a congenital origin. They are cases which have never possessed ordinary mental power. The congenital group contains the following subdivisions:—(*a*) strumous; (*b*) microcephalic; (*c*) macrocephalic; (*d*) hydrocephalic; (*e*) eclampsic; (*f*) epileptic; (*g*) paralytic; and (*h*) choreic.

2. *Developmental idiocy.*—The developmental group includes a smaller number of cases, where the child manifests an average intelligence through infancy, or even up to the commencement of puberty, but, from causes which have influenced the nutrition of the embryo during its intra-uterine life, is born with a proclivity to mental break-down during one of the developmental crises; the crises being the periods of the first dentition, of the second dentition, and of puberty. The group includes those cases in which speech and mental faculties are lost in children in whom previously the intelligence was good—cases where the brain and nervous power were sufficient for their early years, but are insufficient to carry them through evolutional stages. They usually present outward signs, in their prow-shaped cranium or other structural deviations, that the tendency to catastrophe was born with them. The developmental group embraces the following subdivisions:—(*a*) eclampsic; (*b*) epileptic; and (*c*) choreic.

3. *Accidental idiocy.* — The accidental group includes all those cases of idiocy where the child has been born with a normal nervous system, free from any present or potential defect, when unfortunately a fall, a fright, epilepsy, the result of some peripheral irritation, disease of the bones of the ear sequential to measles or scarlet fever, meningitis, or other cause, may lead before puberty to mental break-down—a break-down not of a genetic, but of a purely accidental origin. The accidental group includes:—(*a*) traumatic; (*b*) inflammatory; and (*c*) epileptic idiocy. For the group of idiots produced by endemic influence, *see* Cretinism.

Ætiology.—The production of idiocy is multiform in its causation: often more than one factor has been at work. The *congenital* kinds are produced by neuroses, struma, tuberculosis, alcoholism, over-intellectual work, over-sexual indulgence, and constitutional debility of the progenitors. Syphilis holds but a very unimportant place. Intermarriage of relations, *where there is a constitutional taint*, in consequence of its insuring the existence of two potent factors; fright and emotional disturbance, or anxiety of any kind on the part of the mother during her pregnancy; and prolonged parturition and suspended animation at birth, are also to be reckoned as causes of congenital idiocy. The *developmental* kinds have their proclivity given to them by causes affecting the nutritive life *in utero*; notably emotional disturbances, and sickness produced by the pregnancy or by a prolonged sea-voyage. The exciting cause is a developmental crisis, such as occurs at the periods of dentition, and the evolution of puberty. Masturbation is a most important factor in determining this kind of idiocy. The *accidental* kinds are produced by injuries of any kind to the cranium, sunstroke, exanthematous disease, tubercular or other forms of meningitis, inanition, and epilepsy referable to worms, masturbation, or other sources of peripheral irritation.

Prognosis.—In idiocy the future of the patient will be forecast by reference to the nature of the case. Other things being equal, patients paralysed or epileptic are less amenable to treatment than others, but the most unsatisfactory results are obtained among cases of accidental origin. It is important to recognise the fact that congenital cases, with marked traces of their infirmity in their faces and bodies, are, for the most part, more susceptible of improvement than the developmental, and these again than the accidental, who may have no appearance of idiocy in their faces or bodies; that, in fact, a favourable prognosis is often inversely as the patient is winsome, fair to look upon, and comely.

Treatment.—The treatment of idiocy consists of a judicious combination of medical, physical, moral, and intellectual agencies. The patient should be rescued from his *solitary* life, and have the companionship of his peers. He should be surrounded by influences, both of art and nature, calculated to make his life joyous, to arouse his observation, and to quicken his power of thought. The basis of all treatment should be *medical* in an enlarged sense. Success can only be obtained by keeping the patient in the highest possible health. The dietary should be liberal, containing a fair proportion of nitrogenous elements, while rich also in phosphatic and oleaginous constituents. The food should be presented, too, in a form suited to the masticatory power of the patient. It is of importance that the rooms he inhabits should be well-ventilated, whilst kept warm; and daily baths with shampooing should be employed. Of first importance is the soil: a clay soil is fatal to all proper progress, inducing tuberculosis, and lowering the vital power. *Physical* training forms an important part of treatment. The attenuated muscles have to be nourished by calling into exercise their functions, and the automatic and rhythmic movements have to be replaced by others which are the product of the will. The simplest movements should be first taught, then the more complex, thus causing to grow up together the mandate and the result. From purposeless acts the idiot thus builds up a series of co-ordinated and voluntary movements which are applicable to the wants of daily life. The training has to be carried out in minute detail, so that every voluntary muscle and every congeries of muscles may be called into action, and trained to fulfil with rapidity the end for which they are designed. The *moral* education is of paramount importance. The pupil has to be taught to subordinate his will to that of another. He has to learn obedience, that right doing is productive of pleasure, and that wrong doing is followed by deprivation thereof. Corporal punishment should be forbidden; the affective faculties of the patient should be so cultivated that the withdrawal of the love of his teacher should be felt as the greatest punishment, and the manifestation of it his highest reward. In no case should the punishment interfere with hygienic treatment. The *intellectual* training must be based on a cultivation of the senses. The patient should be taught the qualities, form, and relation of objects by their sense of touch; to apprehend colour, size, number, shape, and relation by sight; to understand the varieties of sound when addressed to the ear; the qualities of objects by the taste and smell. These lessons should be of the simplest at first, and gradually cumulative. Nothing should be left to the imagination. The idiot must be taught the concrete, not the abstract. It is in this way we should give him the basis upon which the reasoning and reflective faculties can be built up. Synchronously with this, use should be made of the physical powers which have been cultivated. He should be taught to dress and undress himself, to acquire habits of order and neatness, to use the spoon or knife and fork, to walk with precision, to handle with tact. The defective speech is best overcome by a well-arranged plan of tongue-gymnastics, followed by a cultivation of the purely imitative powers.

J. Langdon Down.

IDIOPATHIC (ἴδιος, peculiar; and πάθος, a disease).—A term applied to a morbid condition when it arises primarily, and not in consequence of some other disease or injury. It is used in contradistinction to *symptomatic* and *traumatic*.

IDIOSYNCRASY (ἴδιος, peculiar; σύν, with; and κρᾶσις, constitution or temperament).

Definition.—This term, like many others used in science, has a more restricted application than its etymology would indicate. From meaning the personal constitution of an individual, it has come to mean any peculiar and not obviously correlated reactions against external influences exhibited by any individual. It is not to be confounded with 'constitution,' which is the foundation of the individual, his powers, capacities, and organisation; nor with 'temperament,' which denotes the correlation of powers and tendencies with the physical conformation of the individual, which has therefore a generic or race application, and which is defined by some writers as the 'general form' of the man. Commonly, any single peculiarity of a person is spoken of as 'an idiosyncrasy,' so that one individual may, in this sense of the word, manifest several idiosyncrasies or personal attributes.

Description.—Idiosyncrasies, so defined, may be mental or physical; may be innate or acquired; may be permanent or temporary.

The existence of idiosyncrasies being declared chiefly through the agency of nerves, and their operations being mostly capable of being brought under laws of innervation, Prochaska, Claude Bernard, and other authorities have regarded them as 'a peculiar affection of the nervous system.' But a review of the phenomena admitted to belong to the class will be found to compel us to recognise in many cases a more comprehensive relation, involving the whole organism, or parts of it other than the nervous system.

In the enumeration of the principal kinds of idiosyncrasies, to purely mental manifestations of likes and dislikes toward persons, things, and pursuits—affections covered by such terms as 'sympathy,' 'antipathy,' 'predilection,' &c.—must be added reactions in which the mind, the emotions, and the organic nervous system are affected simultaneously, but in varying proportions, by impressions received through organs of sense.

For example, vision may be the channel of affection. Syncope is produced in some persons by the sight of blood; or, as is related by Prochaska, swooning may invariably occur on the sight of beetroot. As regards olfaction, some people are distressfully affected, in both bodily and mental ways, by the exhalations from certain animals, the cat in particular; in others, horror and fainting are induced by the odour of roses or of apples. And so on through the rest of the senses.

In another group of idiosyncrasies the higher nervous centres play no part, the phenomena being of reflex production through the spinal centres, or being due to direct poisoning of the system or of organs. Among foods or drugs swallowed, among gases or dusts inhaled, among substances brought into contact with the skin, many, harmless to the majority of men, are for this or that individual irritants or poisons. For instance, eggs, honey, sugar, or fish may produce gastric pain, nausea, or vomiting; strawberries are to a few persons a most virulent poison, producing symptoms of intense nervous shock; convulsive spasms may be excited by the smell of musk or civet; asthma by the inhalation of the powder of ipecacuanha; urticaria by the eating of shell-fish, or even by the application of the yolk of egg to the skin.

> Some men there are love not a gaping pig;
> Some that are mad if they behold a cat;
> And others, when the bag-pipe sings i' th' nose,
> Cannot contain their urine.
>
> *Merchant of Venice.*

Idiosyncrasies confronting the use of drugs have a special interest for the medical man. They may be of a qualitative nature, as in the production of unusual symptoms with dangerous or fatal results by anæsthetics, or in iodism; or of a quantitative nature, as in the case of opium and belladonna, minute doses of which will poison some persons, while doses of them, large enough to destroy a dozen average individuals, may be taken by one here and there with impunity.

The consideration of this part of our subject introduces the question of the variations of idiosyncrasies. The transient oddities of susceptibility arising in pregnancy, hysteria, and madness, are excluded by some authors from the category; but as they only differ in their transitory character from other idiosyncrasies, we shall here associate them with those modifications of reactive sensibility to which the term is commonly extended. Seeing that the causes of innate idiosyncrasies are for the most part unexplained, we may search out in varying or acquired idiosyncrasies varying correlations which may help us to the ultimate better understanding of the former group. Thus we know that intolerance of opium may arise in some morbid states the nature of which is fairly known; that tolerance of, or comparative indifference to, the same drug may be attained by its constant use. As in pregnancy new idiosyncrasies appear, so age, habits, and state of body may each and all modify the reaction of any individual towards his surroundings; may change his behaviour under the influence of drugs; may at one time charm him against morbid poisons, at another time leave him their easy victim; may make him inflame sometimes in a suppurative, sometimes in a plastic way. From this point of view, we may, with Claude Bernard, summarise idiosyncrasies as being 'mere manifestations of the ordinary laws of physiology.'

Imaginary idiosyncrasies.—Persons are not infrequently met with who, held by prejudice, or misled by fancies or unsound judgments, declare that particular foods and medicines disagree with them. It may often be found, on investigation, that the assertion is incorrect. The obstacles offered to effective treatment by such fancies are sometimes of grave importance, tasking severely the sagacity of the medical man in the way of analysis, and his skill in the way of counteraction. But when the idea of their existence shall have been proved in any case to be unfounded, it is generally possible to evade such obstacles by tact, or to undermine them by argument, and, most of all, to dissipate them by firmness.

William M. Ord.

IDROSIS (*ἱδρώς*, sweat).—A synonym for hyperidrosis. *See* Sudoriparous Glands, Diseases of.

ILEO-TYPHUS.—A synonym for typhoid fever. *See* Typhoid Fever.

ILEUM, Diseases of.—*See* Intestines, Diseases of.

ILEUS (*εἰλέω*, I twist).—A synonym for an intestinal obstruction. *See* Intestinal Obstruction.

ILIAC REGION.—The iliac region, or region of the iliac fossæ, is limited laterally and superiorly by the crest of the ilium, anteriorly by Poupart's ligament, and internally and below by the brim of the true pelvis or inner edge of the psoas magnus muscle.

Anatomical Relations.—That portion of the abdominal cavity which corresponds to these boundaries, contains the following viscera on the right side:—the cæcum, the vermiform appendix, some coils of the small intestines, and the ureter; and on the left side:—the sigmoid flexure of the colon and small intestines, and the ureter.

In front of the cavity is the ilio-inguinal region, which forms its anterior parietes, and from which surface all examinations of the region are instituted. Exploration is difficult in obese persons, and to facilitate it we must relax the abdominal parietes by flexing the thigh, and by pressing the fingers immediately above the crural arch.

The *peritoneum* is but very slightly united to the subjacent tissues, and is easily separated from them. It completely covers in the left iliac fossa; but on the right side, owing to the presence of the cæcum, this investment is incomplete. *See* Lumbar Region.

The *sub-peritoneal cellular tissue* may be regarded as being composed of two distinct layers. The first, immediately beneath the peritoneum, is a continuation of the lax cellulo-fatty envelope of the kidney and cæcum, passing with the femoral vessels into the crural canal, and with the spermatic cord into the scrotum. The deeper or sub-aponeurotic layer lies beneath the sheath of the iliaco-psoas muscle, being continuous above with the sub-pleural cellular tissue, and accompanying this muscle downwards as far as its insertion into the lesser trochanter.

The *arteries* of this region are the common and external iliacs, and their branches.

The *nerves* of the iliac fossa are the lumbar plexus (the trunks of which lie in the iliaco-psoas muscle) and its branches; and the solar, renal, hypogastric, and lumbo-aortic branches of the sympathetic.

The *fascia iliaca* is attached above to the entire inner lip of the iliac crest. Internally it is blended with the sheath of the psoas at the level of the promontory of the sacrum; and below this point it becomes fixed to the brim of the true pelvis, passing behind the vessels and giving off a thin cellular lamella in front of them.

The *sheath of the psoas muscle* is attached above to the ligamentum arcuatum internum; it encloses the psoas anteriorly (the posterior portion of its envelope being formed by the lumbar vertebræ); it is blended externally with the sheath of the quadratus lumborum; whilst internally it is attached to the anterior common ligament. Inferiorly it is continuous with the fascia iliaca.

The *osseous layer* corresponds with the iliac bones.

Pathological and Clinical Relations.—The viscera which have been enumerated above, as being contained in the iliac region of the abdomen, present various diseased conditions, which cannot be satisfactorily diagnosed without a practical knowledge of its anatomical relations, and especially of the fasciæ, sub-aponeurotic, and aponeurotic structures of the iliac region. Thus in the right iliac region the physician meets with tumours and other diseases of the cæcum, vermiform appendix, and lower part of the ileum, including the local lesions of typhoid fever (*see* Cæcum, Diseases of; and compare Hypogastric Region). In the left iliac region, the diseases of the sigmoid flexure possess equally important relations. The tumours, extravasations, and abscesses, which may commence in the pelvis, frequently make their way into either iliac region; and this is also the seat of morbid conditions connected with the ureter in the middle portion of its course, as well as partly of the pain in renal calculus. In the sub-peritoneal tissue we meet with bloody or urinary infiltrations, fæcal abscesses, and perityphlitic or idiopathic abscesses independent of any intestinal lesion. Collections of pus beneath the fascia are often dependent on caries of the vertebræ, and may either be confined to the iliac fossa, or lie within the sheath of the psoas muscle (psoas abscess). Again, lumbar abscesses may point anteriorly, and be diagnosed by palpation of the abdominal walls.

This region is the seat of ligature of the common, external, or internal iliac arteries. The pulsation of the two former can generally be felt; and it must be borne in mind that the abdominal aorta pulsates in the left iliac region. The bowel (large intestine) may have to be opened here, in cases where lumbar colotomy is contra-indicated, and in the writer's opinion where it always should be done. Edward Bellamy.

ILLUSION.—A false or mistaken perception of one of the senses, as when a person sees or hears something, and takes it to be something else. The term has been used as synonymous with delusion and hallucination. Illusions may occur in the sane as well as in the insane. *See* Hallucination.

IMBECILITY.—*See* Dementia; and Idiocy.

IMMUNITY (*immunis*, exempt).—Definition.—Immunity to disease may be defined as a condition, natural or acquired, of the animal body, which renders it resistent to the invasion of one or more infective disorders.

General Considerations.—An animal (or man) in such a condition is said to be *protected* against the particular disease from which it is immune. All the disorders in which the question of immunity occurs are *infective*, that is, capable of being transmitted from one animal to another by means of a contagium vivum, virus, or *primary infective agent*. The question of immunity is closely bound up with the study of this primary infective agent, with its morphology, its physiological life-processes, and the modes by which it produces its pathological effects. The notice here taken of these points must of necessity be brief; but they will be found fully described in the article Micro-organisms.

Morphology of the primary infective agent.—In only a few of the infective disorders in man is the primary infective agent known (*see* Micro-organisms). In these (*e.g.* tubercle, anthrax, diphtheria, glanders, tetanus, relapsing fever, erysipelas, pyæmia, actinomycosis) specific micro-organisms have been found and recognised to be the cause of the disease. In some other diseases—typhoid fever, cholera, and gonorrhœa—the proof that the micro-organisms found are the cause of the diseases is not yet complete; while in one disease (malaria) there is some evidence to show that the primary infective agent is a low form of animal life—a plasmodium or amœba-like body. Until the identification of the infective agent in these and other diseases (such as scarlet fever, measles, small-pox, &c.) is made, the nature of immunity to them, which is of such great importance to man, must remain unsolved. Of greater importance in immunity is the mode of propagation or division of the pathogenous micro-organisms. Some of these, such as micrococci, the vibrio choleræ asiaticæ, the bacillus diphtheriæ, do not form spores, but multiply by fission; while others form numerous spores, which are very resistant to the external conditions of moisture, light, and heat. On the other hand, these conditions affect the non-spore-bearing micro-organisms, and so diminish their virulence. The physiological life-processes of the pathogenous micro-organism are important to the question of immunity under two headings. For their development and growth these infective agents require a suitable medium, which in any individual disease is formed for them or by them from the fluids of the body. In the interstitial fluids of the tissues, and in the fibrin and proteids exuded from the blood in pathological effusions, these infective agents find suitable media for rapid development and growth, and from such media they effect their second important physiological *rôle*, viz. of producing poisonous chemical substances, which, circulating in the body, become the means by which the primary infective agent produces the symptoms, both general and specific, of infective disorders. Unless the infective agent find a suitable medium on which to grow, it cannot form its poisonous chemical products, and cannot reproduce the disease of which it is the cause. This fact is of great importance in considering immunity; and why no suitable medium is present in an immune animal will be discussed later as far as in our present knowledge it is possible.

Besides the fact just mentioned of the physiological life-processes of the infective agents, there are others of equal importance connected with the *pathological effects* of these agents. We have to take into account in considering immunity the following pathological problems: (1) *the degree of virulence or attenuation of the virus*; (2) *the localities in which it grows in the body* in natural disease; with which is associated its mode of distribution and its fate in an animal after experimental inoculation into the circulation, under the skin, or into one of the cavities of the body.

1. Degree of Virulence or Attenuation of the Virus or Infective Agent. One of the facts about the virus of infective diseases which was surmised by clinical experience and has been accentuated by the scientific work of recent years, is that the virus exists in two forms, one virulent and the other attenuated. Thus some cases of typhoid fever undoubtedly die from the intensity of the poison, and may exhibit anatomically no greater changes than exist in a milder but still fatal case. Experiments, however, with pathogenous micro-organisms show this fact in a more exact manner. Thus, Pasteur was able to 'attenuate' the bacillus anthracis, so that when injected into a sheep it did not kill the animal, but produced a mild febrile illness. The bacillus of fowl-cholera was attenuated in like manner. It is well known also to bacteriologists that if a virulent culture of bacillus anthracis be kept for some time, it is apt to become weakened in virulence; and one can approximately express the virulence of such preparations as a 'two-days'' or 'four-days'' anthrax, this being the time in which the preparation would kill a given animal (guinea-pig or rabbit) when subcutaneously inoculated.

Again, if a virulent culture of the bacillus diphtheriæ on agar be kept for some months, even in this state it will be found to become less virulent, and will finally die. Other examples might be given of similar results with other pathogenous micro-organisms. A distinction has been drawn between an attenuated virus and a virus which is simply weakened by age or partial drying, &c. It is said that the attenuated virus always breeds true in artificial cultivation or in the animal body, whereas the slightly toxic virus may by manipulation be made virulent again. It is, however, at present impossible to generalise on this point. The methods of attenuation which are in use are: (1) the passage of a continuous current of air through the liquid in which the bacterium is growing; (2) the successive inoculation of the virus through a series of different animals or of a series of refractory animals; (3) the application of heat and of antiseptics to the virus. Thus many pathogenous bacteria are attenuated by keeping them at a temperature of 45°–50° C. for several hours. Essential oils (such as that of mustard) will also weaken and, if in large quantity, kill pathogenous bacteria. The difference between the attenuated and virulent micro-organisms is not that they produce different chemical products, but that the attenuated have a shorter existence; that, even when they have outside the body the nutrient medium the most favourable to their growth, they stop growing and degenerate. This has been found by some observers also to occur in the body itself—in the case, *e.g.*, of the bacillus anthracis when the attenuated organism has been injected into a sheep. This tendency of the attenuated organism (the vaccine) to die under favourable conditions is an important point in connexion with immunity. The natural history of epidemics has also shown that the virus may be a weak or a virulent one; it is possible that in a mild epidemic we have to do with an attenuated virus, in a virulent epidemic with an intensified one. It is, however, not a complete explanation of the facts, as we shall see.

A weak virus can in some instances be intensified or made virulent again. This has been done by repeated cultivations of the micro-organisms on suitable nutrient media, or by passing the virus through a series of animals—*e.g.* inoculating the first animal with the micro-organism, inoculating the second animal with the blood or tissues of the first, and so on, for five or ten times. Cultivations of the micro-organism from the last animal are found to be very virulent. The vibrio choleræ asiaticæ may be intensified by this method, using guinea-pigs as the animals. Ordinary cultivations of the vibrio are not very toxic, but the intensified virus causes rapid death. A similar micro-organism (vibrio Metschnikovi) has been intensified in like manner.

The fact of the existence of a virus in two states—an attenuated and an intensified—has a bearing on many experimental observations on preventive inoculation, which have led to hasty conclusions, owing to the fact that the virus used to test vaccination was an attenuated and not an intensified one. It is evident that a procedure which would protect against the former might be ineffectual against the latter, and indeed so it has been found.

2. **Seat of Growth of Pathogenous Micro-organisms in the Living Body.** According to the locality of growth of the virus, infective disorders may be divided into three chief classes:—

(*a*) In one, the infective agent distributes itself throughout the tissues of the body. Anthrax is a type of this class. Wherever inoculated, under the skin, into the peritoneal cavity, into the circulation, or into the anterior chamber of the eye, the bacillus anthracis passes to all the fluids and tissues of the body. Glanders is another example: from the usual seat of inoculation, the nasal mucous membrane, the bacillus enters the circulation and the lymph-stream.

(*β*) In a second class, the infective agent becomes limited to the seat of inoculation, producing its effects by the diffusion into the circulation of its poisonous chemical products. In diphtheria, *e.g.*, the bacillus is limited to the membrane, and is never found in the organs of the body; in tetanus, also, the bacillus is limited to the seat of inoculation. In typhoid fever and in cholera it is also extremely probable that the virus is limited to the intestinal walls, never entering the circulation.

(*γ*) There is a third doubtful class, in which the infective agent, although entering the circulation, is limited to the formed elements of the tissues. Thus, in leprosy the bacillus is confined almost entirely to the interior of the cells of the leprous nodule; in malaria, the plasmodium is in the red blood-corpuscle.

It is evident that the question of immunity must be different in these three classes of infective disorders, and that it is fallacious to generalise as to the mode of production of immunity from experiments performed on any individual infective disorder. It is noteworthy, for example, that some of the infective agents, which are localised in their growth (class 2), are incapable of living in the tissues of the body. The bacillus diphtheriæ, if injected into the circulation of the rabbit, rapidly dies, although it will kill the animal.

Having shortly discussed the nature and effects of the agents which cause infective disorders, it is necessary to see more particularly how the results affect the question of immunity.

Immunity may be (1) *natural*; or (2) *acquired.*

1. *Natural immunity.*—Natural immunity includes those cases in which man or any animal does not contract in the ordinary course of events a particular infective disorder, as well as those cases (some of which are now well known) in which it is found difficult, and, in fact, impossible, to infect an animal with a particular disease. Such cases as these are the best examples of natural immunity. The injection, for example, of a virulent infective agent into one animal will not kill it, while a similar or even smaller dose into an animal of another species will with certainty be fatal. Warm-blooded animals, therefore, including man, may, from this point of view, be divided into two classes—those which are *susceptible* to a particular infective disorder, and those which are *refractory.*

The subject will be discussed chiefly from the animal point of view, as this may help to explain the natural immunity to some disorders which is enjoyed by man. The discussion of natural immunity in man includes many other factors besides the condition of health of the tissues of the body. The questions of exposure to infection, of susceptibility to disease according to age, of the influence of climate and temperature, would come more properly under the heading of Ætiology of Disease. There remain, however, these facts: Man is subject to certain infective diseases (*e.g.* typhoid fever, cholera, scarlet fever, measles, diphtheria, &c.), which are not prevalent in animals. Animals (domestic and farm) are subject to certain diseases (*e.g.* swine-plague, contagious pleuro-pneumonia, distemper, black leg, &c.), which do not affect mankind, And, lastly, there are certain infective diseases from which both mankind and animals suffer, viz. tuberculosis, anthrax, hydrophobia, glanders and farcy, pyæmia and pus infection, tetanus. In many of these diseases the primary infective agent is unknown; the question of immunity in them must therefore remain practically open. It is impossible, for example, to discuss the question, in the present state of knowledge, as to why animals do not get cholera or typhoid fever. In others, however, the virus is known, and in some well studied. Special interest attaches to the question of immunity in those diseases which are natural diseases in both man and animals, or which are natural diseases in man and which are infective to animals by means of inoculation of the virus, although these may not suffer from them in the natural course of events. We have in such diseases opportunities for experimentally testing the conditions producing immunity. *Tuberculosis*, of which the primary infective agent is the bacillus tuberculosis, is a natural disease in man, cattle, and pigs. Goats, sheep, horses, and dogs are practically immune to it. It is difficult, although not impossible, to produce tuberculosis in dogs by the injection of the tubercular virus. Positive results are obtained with very large doses injected into the peritoneal cavity. *Anthrax*, a natural disease in oxen, sheep, and in man, is observed also in pigs, goats, and horses; but experiment has shown that adult white rats, Algerian sheep, dogs, and pigeons are difficult to infect, and are in fact refractory to the disease. To *diphtheria*, a natural disease in man, rabbits, guinea-pigs, dogs, cats, monkeys, and cows are susceptible; while rats and mice are refractory, being naturally immune to the bacillus diphtheriæ. To *cholera* no animal can be said to be susceptible, although the intensified vibrio choleræ asiaticæ (Koch) is fatal to dogs and guinea-pigs, but is not so active in rabbits. In many instances this natural immunity, as tested by inoculation, is not an absolute quantity: it is, in fact, a quality possessed in varying degree by the several animals called refractory to a disease. Thus dogs may be regarded as practically immune to the bacillus tuberculosis, even large doses inoculated subcutaneously producing no effect. To the bacillus tetani they are immune to a less degree: a large dose subcutaneously will be fatal, while a small dose will produce a mild illness ending in complete recovery. Adult white rats are refractory to the bacillus anthracis only in a minor degree. If a large number be inoculated with a virulent virus, less than half will die of the disease, the remainder showing only a passing illness or no illness at all. Pigeons, too, can be killed with the bacillus, although many survive and show a lesion at the site of inoculation. It is asked, What is the reason of this immunity—what physiological difference is there between the cow and the dog, that the former is very susceptible to tuberculosis, the latter eminently refractory? or between the French, Russian, or English sheep and the Algerian, or between the young rat and the adult white rat, that the former acquire anthrax and the latter not? or that a well-bred pig is susceptible to swine-erysipelas and a mongrel refractory? The investigation of these facts is the point of the question under discussion, and has led to the discovery of important facts bearing on immunity to disease.

2. *Acquired immunity.*—In man there is perhaps some evidence to show that one attack of an infective disorder protects the individual against subsequent attacks; but the truth in the matter is difficult to ascertain owing to the absence of correct records. There is no doubt that an attack of small-pox is protective, as the results of the now obsolete inoculation showed. It is, however, an assumption that one attack in every case of an individual disease confers immunity. There is, indeed, some evidence to show that an attack of erysipelas or of tuberculosis not only does not confer immunity, but actually predisposes to subsequent attacks. But this point of view of the subject is so hedged by difficulties that little good would come from a discussion of it. It will be best, therefore, to pass on to the question of immunity acquired experimentally. The basis of most of the experiments performed is that an attack of a disease protects against a subsequent attack, and that, although the first attack must be mild, it must not be too mild, or no protection is afforded. It will not be too much to say that all recent experiments in immunity have been based on the idea of the protection afforded by vaccination against small-pox. *See* SMALL-POX; and VACCINATION.

Preventive Inoculation.—*Preventive inoculation* has been claimed to have been performed by three classes of products—(1) by the *attenuated virus* of the disease; (2) by the *chemical products* of the virus or primary infective agent; (3) by *chemical substances which are not the products of bacterial growth.*

(1) *Immunity conferred by the attenuated virus.*—There are now several examples of this known to experimental science. The best is that of anthrax (Pasteur). The bacillus anthracis when attenuated may be obtained as in two kinds of vaccine, called *premier* and *deuxième vaccin.* The *premier vaccin* is injected subcutaneously in sheep, and is followed after an interval by the injection of the more powerful *deuxième.* The animal is after a time, but not immediately, immune against anthrax, and the immunity lasts probably nine or ten months. The changes which the inoculation produces will be discussed later. Pasteur similarly attenuated the bacillus of fowl-cholera, and thus manufactured a vaccine against the disease. It has not been found possible to attenuate the virus of all diseases so that a vaccine can be prepared. The attenuated cultures of the bacillus tetani do not confer immunity against subsequent inoculations of virulent cultures

of the bacillus; rabbits, however, have been made immune by injecting the bacillus and treating the animals subsequently with trichloride of iodine. This substance prevents the fatal result, but appears to allow the bacillus to grow sufficiently to produce immunity. Tizzoni and Catani, utilising the fact that dogs and pigeons are refractory to tetanus, obtained a vaccine from the blood of these animals *after* they had been inoculated with the bacillus tetani, which produced an illness but not death. This vaccine will be the subject of further consideration. The bacillus diphtheriæ which has been attenuated simply by the *age* of the culture does not act as a vaccine. Brieger and Fränckel have, however, found that a three-weeks-old broth-culture of the bacillus, when warmed to 60°–70° C., protects guinea-pigs against a subsequent inoculation of the virulent bacillus, provided that the second inoculation does not take place until fourteen days after the first. Behring also obtained a diphtheria vaccine by growing the bacillus with trichloride of iodine. By different methods, therefore, an attenuated virus can be obtained which will act as a vaccine. The method employed by Pasteur for obtaining an attenuated virus of hydrophobia is described elsewhere. *See* HYDROPHOBIA.

(2) *Immunity conferred by the chemical products of the virus or primary infective agent.*—There are a few examples which show that the chemical products of the virus may afford a certain amount of protection against a subsequent inoculation of the virulent virus. Thus, with anthrax, the bacillus was grown in solution and killed by heat; the solution remaining acted as a vaccine against anthrax (Toussaint, Chauveau). Similarly with the bacillus pyocyaneus (the bacterium of blue pus) and with the vibrio choleræ asiaticæ. The products of the bacillus tetani can serve as a vaccine if treated by heat. Cultures of the bacillus are filtered to remove the micro-organism and subsequently heated to between 50° and 60° C.; when the liquid is repeatedly injected into rabbits the animals are rendered immune to the disease (Vaillard). Instead of heat, a solution of iodine may be used to weaken the poison. To hog-cholera, the infective agent of which is the *cocco-bacillus suum*, immunity may be produced in rabbits by heating to between 54° and 58° C. the blood of animals killed by the micro-organism. It is probable in this case that the vaccine is really the chemical products of the cocco-bacillus. In many instances of chemical vaccination the vaccine is inadequate, and the injection of vaccinating fluid must be regularly performed before protection against the disease is obtained. It has been stated that one class of bacterial products, viz. albumoses, is very efficient as a vaccine, but this has not been confirmed.

(3) *Immunity conferred by chemical substances of a non-bacterial origin.*—Most of the facts ascertained under this heading are still *sub judice*, but they promise a fruitful field for investigation. Wooldridge showed that some protection in rabbits was afforded against anthrax by the intravenous injection of a solution of tissue-fibrinogen, a peculiar form of globulin obtained from certain tissues; and that this effect of protection was intensified if the bacillus anthracis was previously grown a short time in the solution of fibrinogen, and removed before the solution was used as a vaccine. These experiments were the starting-point of many others which tended to show that there existed a class of bodies provisionally called 'defensive proteids,' which were vaccines for individual infective disorders. Thus experiments have been performed to show that the blood and spleen of animals naturally refractory to a disease contain chemical bodies ('ferments' or 'proteids') capable of vaccinating against the disease. The blood of the dog, an animal refractory to anthrax, *e.g.*, has been said to contain a 'ferment' which is a vaccine against the bacillus anthracis; and the spleen of the rat, which is also refractory to the same disease, is said to contain a vaccinating globulin. These experiments have not been confirmed, and the vaccinating influence of these bodies is very slight, if it exists at all.

Changes occurring in the Animal Body, the Result of Inoculation.—The injection of the attenuated virus or of the bacterial chemical products produces a definite illness which is transient: it consists in a rise of body-temperature, lasting a variable time, and a few general symptoms, described as malaise and lassitude, &c. The intimate chemical changes are but little known. Some of the experiments which have been performed are, however, not without interest. Immunity to the bacillus tetani has been conferred on rabbits, as previously stated, by treating the animals with trichloride of iodine; the animals were subsequently inoculated with the bacillus. The blood drawn after some days from the carotid artery was found not only to confer immunity against the bacillus tetani in mice, which are very susceptible to the disease, but to destroy the tetanus chemical poison (Behring and Kitisato). Pigeons and dogs are refractory to tetanus; inoculations with the bacillus made the animals ill, but did not cause death, the animals being after treatment immune against the injection of very virulent cultures of the bacillus. The blood-serum of these protected dogs killed the tetanus poison (outside the body) and conferred perfect immunity on another dog and on mice, but did not protect rabbits and guinea-pigs against inoculations with the bacillus (Tizzoni and Catani). In the case of rabbits protected against hog-cholera, the serum of the blood acts as a vaccine against the cocco-bacillus suum, but it possesses no bactericidal or anti-toxin property, and does not attenuate the bacillus (Metschnikoff). This change in the blood shown in these experiments with tetanus or hog-cholera is a remarkable one, and cannot at present be expressed in any chemical terms. The experiments require confirmation. The fate of the attenuated virus in the body has been studied with somewhat fruitful results. In anthrax it may be limited to the site of inoculation, or it may to some extent distribute itself over the body, especially in the spleen. In either case it dies, becoming degenerated. A similar effect has been observed when the virulent virus has been inoculated into a protected or a refractory animal. It is noticeable that in many cases protective inoculation is effective for only a very short period, reckoned by days, while in other cases there is no protection until *after a certain period* reckoned by days, and that 'vaccinated' animals inoculated with the virulent virus before this period has elapsed actually show a greater susceptibility to infection than the non-vaccinated.

Nature of Immunity.—The intimate changes, both chemical and anatomical, occurring in the bodies of immune animals are imperfectly known. It is not, therefore, surprising that an explanation of the real nature of immunity is not at present forthcoming. Both in natural and acquired immunity there is an antagonism between the body and the invasion of the virus or primary infective agent—an antagonism which results in the victory of the tissues. In susceptible animals there may be some antagonism, but the virus is triumphant. The question is, What is there in the body of an immune animal which antagonises the growth of the virus, preventing it producing its chemical products, which are the cause of death? Does the antagonistic agent reside in the fluids of the body or in the cellular elements? Is immunity a question of chemical antagonism or one of vital antagonism—the combat of cells against the virus (*phagocytosis*)? Much harm has undoubtedly been done by generalising from isolated experiments. The virus acts in a particular manner in individual infective disorders: in anthrax it is diffused through the body, in diphtheria it is localised to the throat, and in tetanus to the seat of inoculation, as already stated. It is, therefore, improbable that the explanation of conferred immunity is the same in all disorders; and, as we have seen, no single method of conferring immunity is common to all infective diseases. With vaccines which consist either of the attenuated virus, or of the chemical products of the virus, it is important to bear in mind the following considerations. The attenuated virus injected into an animal produces an illness by means of the chemical products it forms, which are carried through the blood and lymph-stream over the body. These products are formed slowly, and are eliminated slowly, so that their effect on the tissues is a prolonged one, lasting probably after all evident symptoms have subsided. These products, at any rate in the case of the bacillus anthracis, are of the same nature as those produced by the virulent bacillus; they may, therefore, by their specific action prepare the tissues for receiving a larger dose of the poison—they may accustom the animal to the bacterial poison. This idea is rather confirmed by the fact that in some cases (*e.g.* diphtheria) the animal is not immune until some time after vaccination; if inoculation with the virulent virus is made before the period has elapsed, the animal dies *more* quickly than usual. In the case of some chemical poisons this action is well known, as in the establishment of the 'morphine-habit,' and it has been demonstrated with snake-poison (Sewall) and the poison of *Abrus precatorius* (jequirity). Both these poisons bear a close relation to some bacterial poisonous products; and in both, repeated small doses protect an animal against a single large and fatal dose. With a living virus the case is, however, different: the effect of a chemical poison lasts but a short time; that of a living virus is constantly increasing until the susceptible animal dies. We are still, therefore, confronted with the question why the virulent virus does not produce its fatal results in a protected or refractory animal. No bacterium will flourish unless it has a suitable medium; and pathogenous micro-organisms are peculiarly sensitive to their surroundings. The vaccine may change the cultivating medium usually existing in the susceptible animal, so that the virulent virus will not develop; and this is in accord with the fact that experimental vaccination confers, as a rule, a very temporary protection. The isolated experiments which have been adduced to prove that the cultivating media (*i.e.* the fluids of the body) are so altered in both natural and acquired immunity that they are inimical to the primary infective agent, are not very satisfactory. The following examples may be quoted as showing that no explanation of the problem is at present complete from a study of the experiments already performed. The blood-serum of the rabbit, an animal susceptible to anthrax, kills the bacillus anthracis; while the blood-serum of the dog, an animal refractory to anthrax, is not harmful to the bacillus. Similarly, the serum of a vaccinated sheep is not more harmful to the bacillus anthracis than that of an unvaccinated. The experiments with the serum of rabbits protected against hog-cholera have already been quoted. Such experiments are, however, not conclusive, as serum does not exist as such in the living body; and immunity may still be found to be in part effected by altering the cultivating medium in the living body. In one case of vaccination (that for tetanus) there is a profound change in the blood; the experiments have already been quoted. In them it was shown that after a dog had been inoculated with the tetanus bacillus its blood-serum had the power not only of conferring immunity on another dog and on mice, but of killing the tetanus chemical poison. The supposed substance has been called tetanus 'anti-toxin.'

Phagocytosis.—The chemical examination of immune animals is of great importance; but the facts now known are so inconclusive that it is impossible to state their exact bearing on the question of immunity. An anatomical study of the tissues of immune animals has led to the discovery of interesting facts, dealing chiefly with the fate of the virus when it is injected into protected animals or those naturally immune. The theory of phagocytosis is held by Metschnikoff to explain the phenomena of natural and acquired immunity. Phagocytes are cells which have the power of taking into their interior solid particles, dead or living; and are of two kinds. One form, called *microphages*, are the leucocytes or migratory cells of the body, with a lobed or multiple nucleus; the other kind, *macrophages*, are such as 'the fixed cells of connective tissue, the lining cells of the pulmonary alveolus, and all other cells capable of taking in solid particles, and containing a single large nucleus less easily stained than that of the microphages.' According to this theory, natural immunity is due to the fact that the phagocytes take into their substance the virulent virus when it gains entrance into the body and destroy it. In animals susceptible to any particular disease, on the other hand, the phagocytes, although they may take in the virus, are unable to destroy it; it gains the upper hand and produces the disease. In acquired immunity the phagocytes are so affected that they are enabled to successfully combat the micro-organism and destroy it, losing this acquired property when the animal becomes again susceptible, as it usually does. The fact that leucocytes ingest particles has long been known; they are active agents in the normal absorption of fats from the intestine, and in normal conditions they have been found to contain some of the numerous bacteria of the intestinal contents. Metschnikoff has made an extensive investigation into two cases of natural immunity, viz. that of the pigeon and of the adult white rat against anthrax. Although the immunity is not perfect, many animals recover from the inoculation of virulent bacilli anthracis; and in such cases he has stated that there is an abundant phagocytosis, the microphages and macrophages containing the majority of the injected bacilli. When abundant phagocytosis does not occur, the animal becomes affected with anthrax and eventually dies. The bacilli injected are not solely the dead ones, but are in many instances at least living.

When protected animals, moreover, are inoculated with a virulent virus, Metschnikoff states that an abundant phagocytosis occurs; for example, in animals vaccinated for anthrax by the attenuated virus. Also in rabbits vaccinated against hog-cholera in the manner already described, when they are inoculated with the virulent cocco-bacillus suum, these bacilli are taken up by the microphages and macrophages and destroyed by them. In this case, although the blood-serum is a vaccine, it cannot kill or attenuate the bacillus; and Metschnikoff concludes that it probably stimulates the phagocytes. In other cases it is supposed that the chemical products of the virus (such products being the vaccine) attract the leucocytes to the spot, and stimulate them to attack the bacterium. Some chemical substances are known to attract leucocytes, others to repel them; the former are described as exerting a *positive chemotaxis*, the latter a *negative*. Chemotaxis is an observed phenomenon; but as a theory in connexion with phagocytic immunity it fails to explain what gives the power to the leucocyte and other cells of the immune animal to destroy the virulent virus. The exact *rôle* which phagocytosis plays in immunity, and that which the chemical constituents of the body play, must at present remain unsettled.

IMMUNITY AND CURE OF DISEASE.—The question of immunity is closely connected with that of the cure of disease. In the present state of knowledge, but little, except of a theoretical kind, can be said on this point. Immunity is the prevention of the growth of a virus after it has been introduced; cure is the prevention of its further growth after its development has commenced and the symptoms of disease have already appeared.

Antagonism of infective agents.—Only brief notice can be taken of this point. The growth of two infective agents may be concurrent in the same animal body. They may or may not neutralise each other. The concurrent or after development of pus micro-organisms in connexion with tubercle, diphtheria, and typhoid fever is known—here there is no antagonism. There are, however, several experimental examples of antagonism of micro-organisms. Thus the bacillus pyocyaneus or its products will counteract the bacillus anthracis; and it has been stated that the bacillus pneumoniæ (Friedlander) and the micrococcus erysipelatis will each counteract the bacillus anthracis. Such isolated facts as these are not without importance, as they indicate one method by which it may in the future be found possible to treat an infective disorder.

SIDNEY MARTIN.

IMPETIGINODES. — Impetiginous; that is, having the character of impetigo; hence, eczema impetiginodes. *See* IMPETIGO.

IMPETIGO (Lat. A scabby eruption).—SYNON.: *Impetigo Contagiosa*; *Porrigo Contagiosa*; Pustular Dermatitis.

DEFINITION.—An inflammation of the skin attended with a vesico-pustular eruption, which is easily reproduced by inoculation.

ÆTIOLOGY.—One of the most interesting facts with regard to pus formation in the skin is the ease with which it can be inoculated, producing an eruption which under favourable conditions develops into impetigo. The important point is, that the source from which the pus is derived does not much affect the character of the eruption; it may be obtained from another pustular eruption, a whitlow, or even a boil, or some other source; and, provided the inoculation is made under favourable conditions for its development, a vesico-pustular eruption on the skin is the result. It is true that some forms of pus are more active or virulent than others; but the general fact holds good, that all pustular eruptions are inoculable. From this we should expect that impetigo would be a local affection, and more or less of traumatic origin; and this is generally the case. The development of pustules may occur in the course of many diseases of the skin, such as eczema, scabies and morbus pedicularis, but in all these cases the formation of pus is not a necessary part, but rather an accident of the inflammatory process. It will be seen from the above that impetigo is not a well-defined disease like psoriasis or zona, but simply a local pustular eruption. As all forms of impetigo are inoculable, it is not necessary to draw any distinction between impetigo and 'impetigo contagiosa.' It would be impossible to describe every circumstance under which impetigo may occur. In its best-known and most common form it is met with on the scalp and face of the poor and dirty children of our large towns, and is often associated with pediculi capitis. In these cases the pustules are so quickly broken by the scratching of the child that they are seldom seen in a perfect state. On examining the head we find scabs, which mat the hair together and cover a superficial excoriation. The pus is often transferred from the scalp, by scratching, to the nose and lips, in which region the real character of the eruption can be more easily examined.

DIAGNOSIS.—The following points will especially distinguish impetigo from ordinary eczema: (1) Each spot appears as a single vesicle or small group of vesicles, without the surrounding skin being red and inflamed, very unlike the first appearance of a patch of eczema; (2) it is easily inoculated; (3) it is usually unsymmetrical, and more distinctly a local affection than eczema; (4) it is unattended with itching, unless complicated with pediculi or eczema; (5) it is almost entirely a disease of the poor and dirty classes, and chiefly confined to children; (6) the children who suffer long from it are always pale and badly nourished; (7) pediculi capitis being the most common cause, it follows that the occiput is the most common primary seat of the disease; it is thence transferred to the nose and corners of the mouth, or from person to person; (8) when the occiput is affected, the glands in the neck are quickly enlarged.

TREATMENT.—Impetigo of the scalp is easily cured by white precipitate ointment, which heals the sores and at the same time removes the cause. On the body the best local application is a thick lotion made of calamine, zinc oxide, and lime-water; this should be painted on with a brush and allowed to dry on, so that a crust is formed. If pus collects under this crust, it should be removed, and the excoriated surface painted again with the lotion. When the crusts remain firmly attached, the cure is soon effected. Tonics, especially iron and wine, are useful; and attention must be paid to diet.

ROBERT LIVEING.

IMPETIGO CONTAGIOSA. — *See* IMPETIGO.

IMPOTENCY (*in*, not; and *potens*, capable).—SYNON.: Fr. *Impuissance*; Ger. *Impotenz*.

DEFINITION.—Impotency may be defined as incapacity in the male for copulation, and is to be distinguished from sterility, that is incapacity for procreation. Cases of impregnation without penetration have been recorded, but, as a rule, impotency involves sterility. A man may be sterile without being impotent.

Impotency may be complete or partial, permanent or temporary.

CAUSES.—Deformity, congenital or acquired, of the external genitals may produce impotency. Extreme degrees of epispadias or hypospadias, or a permanent rudimentary condition of the penis, may cause it. Elephantiasis of the penis or scrotum, a large hydrocele of the tunica vaginalis, a large irreducible scrotal hernia, or tumours, benign or malignant, of the penis may mechanically hinder penetration. Cicatrices, resulting from wounds or disease of the penis, a rigid contracted frenum præputii, or even a permanently adherent prepuce may cause such distortion of the organ during erection as to render copulation impossible.

Usually, however, impotency is of nervous origin. Erection of the penis is caused by an increased inflow of blood combined with diminished outflow. The latter is effected by compression of the dorsal vein at the root of the penis by fibres of the accelerator urinæ muscle. The increased inflow is due to relaxation of the muscular fibres in the supplying arteries and in the cavernous tissue of the penis. This relaxation is produced by the nervi erigentes, which transmit impulses originating in the ganglion cells of the erection centre in the lower part of the spinal cord. This centre is itself excited either reflexly by stimulation of peripheral nerve-endings, or perhaps sometimes automatically by the quantity or quality of the blood supplied to it. Partial or complete loss of the glans penis may thus, by destruction of the nerve-endings, impair or prevent the reflex excitation of this centre. But it is also connected by fibres in the spinal cord with higher centres in the cerebrum, which can inhibit or excite its action. Impotency may therefore result from disturbance of the due relation between the several parts of this complex nervous apparatus, or from injury, disease, or degeneration of it.

Impotency of nervous origin may be classified as *psychical*, *irritable*, and *paralytic*.

Psychical impotency results from the undue predominance of the cerebral inhibiting centres. In newly married men, who have previously led chaste lives, it may be induced by want of self-confidence—excessive apprehension of inability to perform well the duty of the sex, a feeling which is often greatly aggravated by the perusal of the productions of quacks and other impostors. In such cases a tonic may be prescribed, and the patient be directed to abstain from all attempts at intercourse whilst under treatment; and we may rest satisfied that not many days will pass over before nature asserts her empire. Encouraging assurances will do more in effecting a cure than stimulating medicines, or any sort of medical treatment. A single success banishes at once all fears, and gives security for the future. But in cases where excessive venery or masturbation has been practised, there may be diminished excitability of the lumbar centre. The condition is usually of very brief duration. More rarely impotency may be experienced in attempted intercourse with one person and not with others. Possibly the inhibition in such cases is reflex, and excited by some peculiarity in the female.

Irritable impotency is the result of undue excitability of the nervous centres. It occurs after habitual masturbation or excessive venery. The semen is ejaculated before penetration has been effected, and the erection speedily subsides.

Paralytic impotency may be due to injury, disease, or degeneration of the nervous centres. The numerous recorded cases where impotency, permanent or temporary, has followed injuries to the head or back, can only be explained by the assumption of some affection of the nervous system. Diseases and injuries of the spinal cord, producing paraplegia, necessarily prevent active copulation; but if the spinal lesion be above the erection centre, erection and connexion might be possible, the man being a passive agent. Cases are recorded where even impregnation has occurred in such conditions.

Some drugs are credited with producing impotence. Arsenic, according to Charcot, when taken for a long time, has this effect, but virility is regained when the drug is no longer taken. Opium-eating and excessive indulgence in tobacco have been similarly accused. Diuretics, as the nitrate of potassium and bicarbonate of sodium, are well known to act as anaphrodisiacs.

Virility is more or less affected by constitutional diseases. Few complaints have greater influence in impairing the generative functions than those of the kidney. In irritative dyspepsia, with deposits in the urine of earthy phosphates or oxalate of lime, there is generally some inability. Impotency in these cases is only one of the manifestations of defective assimilation and depressed vital force. In diabetes and albuminuria the reproductive organs are weak and often quite inactive, but may regain tone as the organs are restored to a healthy state. Gout and hepatic disorder also may temporarily produce a similar condition.

Impotency sometimes occurs in middle life without any obvious cause. In such persons the writer has noticed a constitutional change similar to that which occurs in eunuchs, but less marked. They have been observed to grow sleek and corpulent, to have a scanty beard, and to be indisposed to active muscular exertion. In general they evince no unhappiness at their altered condition. In atonic impotency, the external organs afford indications of the want of power. Not only are the testicles soft and flaccid, from the absence of blood in the vessels and sperm in the tubes, but the penis is small and shrivelled, and the glans relaxed. The scrotum is also loose. These parts are pale, feel cold, and their sensibility to contact is diminished.

Treatment.—Certain medicines, reputed to possess the property of stimulating and invigorating the sexual organs, have been classed as *aphrodisiacs*, and some of them are said to be used, especially in the East, by the sensualist, to excite the organs when exhausted by satiety and excess. Several act on and stimulate the urinary organs, and thereby give temporary power to the function of erection; but they produce little or no effect on the special sexual organs. They determine blood to the penis, and cause morbid erections, without any voluptuous sensations and desires. Such appears to be the character of the influence produced by cantharides, the most common of this class of medicines, and the chief ingredient of quack medicines for impotency. There are, however, certain cases in which cantharides is useful. In an atonic state of the organs, in which the erections are feeble, unstable, and insufficient, ten to fifteen minims of the tincture may be given every three or four hours for a short time before the occasion arises for the exercise of the sexual functions. Diluted phosphoric acid, phosphate of iron, strychnine, and ergot of rye are remedies which may be given in impotency. The conditions to which these aphrodisiac remedies are chiefly applicable is when the intromittent organ is but feebly excited, and does not maintain the physical state necessary for penetration, during the period of congress. Such torpidity may exist in persons in whom desires are at times strongly felt, and the functions of the testicles properly performed. In these cases, also in timid persons, and in others whose organs are inexcitable from long disuse, stimulating treatment may conduce to success, and ensure confidence for the future. But these remedies exert no influence in a constitutional apathy of the sexual functions. They have rarely, also, more than a temporary effect; and in persons advanced in life, when the parts, having fulfilled their office, are experiencing their natural decline, they operate injuriously, and tend to produce congestion of the prostate and local disease. In those cases in which the sexual organs are weakened or prematurely exhausted by excess, they are likewise hurtful, as well as fruitless. After such abuses a period of repose is required; and by the avoidance of all sources of excitement, and by diet and remedies adapted to invigorate the body, such as the preparations of iron, a gradual restoration of the procreative functions may be hoped for.

Electricity is a remedy of some efficacy in certain forms of impotency. Interrupted currents (faradic) may be passed in two directions, from the perineum to the glans penis in cases of defective erectile power, and from the groin along the spermatic cord to the testicles in cases where these organs are soft and flaccid, and where secretion is languid. The results are often disappointing. Still, a few applications of the electric current, by rendering the glans more sensitive, may cause a more persistent distension of the organ under the natural excitement. Electro-magnetism sometimes succeeds in impotency of this character in rousing a dormant power, causing secretion to be resumed and erections to return. The special treatment required in cases due to injury of the central nervous system, after recovery from head-symptoms, is the use of electricity, applied from the occiput along the spine. *See* STERILITY IN THE MALE.

T. B. CURLING. JEREMIAH MCCARTHY.

IMPULSE (*impello*, I thrust forwards). A sensation of a stroke communicated to the hand, for example, by the action of the heart or by the pulsation of an aneurysm; or by the sudden movement of a fluid when agitated in any way (*see* PHYSICAL EXAMINATION). The term is also employed in connexion with a mental condition in insanity. *See* INSANITY, Varieties of.

IMPULSIVE INSANITY.—*See* INSANITY, Varieties of.

INCARCERATION (*in*, in; and *carcer*, a prison).—That condition of a hernia in which it cannot be reduced, on account of obstruction at the neck of the sac or from some other cause. *See* HERNIA.

INCOHERENCE (*in*, not; *con*, together; and *hæreo*, I stick).—Inconsecutive or 'wandering' thought, as expressed in speech. *See* CONSCIOUSNESS, Disorders of.

INCOMPETENCE (*in*, not; and *competo*, I meet accurately).—In its general sense this term signifies inability of a part to perform its functions. It is mainly applied to imperfection in the closing apparatus of an orifice, such as the valves of the heart (insufficiency) or the pylorus. *See* HEART, Valves and Orifices of, Diseases of.

INCOMPRESSIBLE.—Incapable of perceptibly yielding to pressure. Usually applied to the pulse. *See* PULSE.

INCONTINENCE (*in*, not; and *contineo*, I hold).—In medical language incontinence signifies inability to retain the urine or fæces, so that they are discharged involuntarily. *See* DEFÆCATION, Disorders of; and MICTURITION, Disorders of.

INCUBATION (*incubo*, I hatch).—DEFINITION.—The development of disease from infecting particles, and the time occupied in the process.

PERIOD OF INCUBATION.—The period of incubation is the interval between exposure to infection and the appearance of the resulting disease. It is divided into two stages—those of *latency* and of *invasion*. The one has reference to supposed changes in the infecting particles, the other to noticeable changes in the health of the person infected. The first stage is of variable duration and without definite symptoms; and in the second stage the disease is progressing and the patient is said to be 'sickening for it,' its duration being nearly constant for each special disease. The division is not well-marked. There are changes in the so-called latent period which do not always escape detection, while those of the invasion have often to be considered as part of the disease. Where the latent stage is much prolonged a *dormant* period is inferred, for it is possible that infection may remain in the body for a time dormant. This term is only applicable to certain conditions under which infection is transmitted; and instead of speaking of the long intervals of inactivity at which epidemics recur as periods of latency or of incubation, it is to these periods of quiescence that the term 'dormant' should be restricted.

The results of septic infection are manifested in the body without any true or definite interval of incubation.

Incubation properly refers only to the latent periods of infection in the acute specific diseases; still it is sometimes convenient to reckon the period of incubation as extending to the full development of the more characteristic signs of each of these diseases.

The duration of this period differs for different classes of infectious diseases, and in a less degree for each disease. It varies within certain limits for the same disease, but is sufficiently constant to afford some distinctive characters useful in diagnosis, and a knowledge of which is essential to preventive medicine. The germs of all the infective diseases are reproduced in the bodies of the sick; to stop infection the susceptible who have been exposed to it should not mix with others till the incubation-period has passed with no signs of illness. Hence it is important to ascertain the laws regulating the incubation of each specific infection, and to define the limits of variation. The invasion-stage of all these diseases is already infectious.

1. *Variola* and *Vaccinia*.—In small-pox, after infection, the eruption occurs in fourteen days, and marked illness begins two days sooner. This is so well established as to afford a guide to the source of infection, by which it may frequently be discovered. Dr. Gregory's experience only furnishes one case in which the interval was prolonged to fifteen days. As short an interval as twelve days may be met with, though rarely, in small-pox modified by vaccination or by a previous attack. Small-pox by inoculation is developed in nine days; a local vesicle appears on the fourth day, there is glandular sympathy on the sixth, and febrile disturbance on the seventh and eighth days. Exactly this course is observed in vaccinia resulting from vaccination.

2. *Varicella*.—Chicken-pox has an incubation-period varying from ten or twelve to fifteen or even nineteen days. The eruption begins with the first symptoms of illness.

3. *Morbilli*.—Measles has twelve to fourteen days of incubation, reckoning to the full rash, or eight to ten days from infection to the sickening. The latent period may be only four or six days, that of invasion may extend to six instead of four days. The general experience of schools and hospitals gives ten days from the eruption in the first cases to the appearance of the rash in the next series of attacks. Measles results from inoculation in seven or eight days; the shortest instance from infection, one of fifty cases traced by the writer, was eight days; the two longest, sixteen and eighteen days; but it may possibly extend to twenty-one days.

4. *Rubella*.—Rubella has an incubation-period of not less than ten to fourteen days, frequently extending to seventeen or twenty-one days. A short illness, not exceeding one day, precedes the rash.

5. *Mumps*.—Mumps usually takes from fourteen to twenty-one days for incubation; the shortest period is ten days; the longest that has come under the writer's observation was twenty-two days. Symptoms referable to the invasion-stage may be noticeable for a week before the swelling of the parotids; the latent stage may continue from eight days to twenty.

6. *Pertussis*.—This generally has one week, or even two, of incubation before the first febrile and catarrhal symptoms appear; there is often a latent period of only four or five days, as some cough may precede the fever. The distinctive cough is seldom heard till after the second week; the shortest period in which it has been known to occur is eight days.

7. *Influenza*.—Influenza has a short incubation, from a few hours to two or three days.

8. *Scarlet Fever*.—Scarlet fever has a short incubation-period. From three to five or six days is the time in which the disease is usually declared; it may appear in less than two days; the longest interval is seven or eight days. There are instances where exposure to this infection has produced no effect until after some accident or surgical operation, the rash then appearing in from three to five days. Supposing a previous infection, twelve days would not be too much to allow for such possible extension of the incubation-period. After removal from a source of scarlet fever, those who have no symptoms of the illness within one week will generally escape.

9. *Diphtheria*.—Diphtheria may be developed in three or four days; an interval of from six to eight days is not infrequent. Sometimes two or three days' fever precedes the first local signs; or these may appear at the very commencement, and the incubation be reduced to a single day. On separating the healthy from the sick, more than a week—possibly a fortnight—should elapse before immunity can be predicated.

10. *Typhoid Fever*.—In enteric fever, the occurrence of the first symptoms, in a large number of cases traced by Sir George Buchanan, was eleven days after the operation of the cause, many other cases occurring two or three days later. Dr. Hunter, of Linlithgow, gives one case, with a single definite exposure, where the prodromata occurred in the early part of the third week, with a rigor at the end of it, twenty-one days elapsing before the fever was marked. Certain interruptions to the febrile process may still

further prolong the interval. An incubation-period of only five days has been noted, once from contaminated milk, and once from infection. There are instances of an eight days' incubation when some of the poison had been inhaled.

11. *Typhus.*—Typhus has, in the great proportion of cases, twelve days of incubation. The late Dr. Murchison gives three cases that have exceeded this period by two or three days, and one of twenty-one days; ten of his cases fell short of it by two, six, or eight days; one of these did not exceed two days; and in two of them the latent period must have been a few hours only. The distinctive rash appears on the fourth or fifth day of illness.

12. *Relapsing Fever.*—This fever has five days of incubation; this exactly agrees with the life-history of the *spirillum* observed in the blood during the fever. The incubation-period may, however be prolonged to seven, nine, or twelve days, or shortened to two days. Many cases have followed almost immediately on exposure to a concentrated infection.

13. *Plague.*—Plague is communicated in from two to five days. The fever may commence on the first day, the glandular swellings on the third, or sometimes glandular tenderness begins with the fever. A period of four days suffices to set up the constitutional symptoms when the plague is conveyed by inoculation.

14. *Yellow Fever.*—Yellow fever has a short incubation of from two to six days, rarely exceeding eight days. Dr. Cargill, of Jamaica, gives a case fatal the day after exposure to infection.

15. *Dengue.*—Dengue is quickly developed —usually in three days. The febrile ingress is sudden, and precedes the rash only by a few hours.

16. *Cholera.*—Incubation in cholera lasts from a few hours to four days. The reports of numerous commissions give from one to five days, within five days, before the third, and not later than the fourth day. Individual cases often fall on the second or third day; the premonitory diarrhœa should be considered as part of the disease.

17. *Malaria.*—The infection of true malaria is not given off by the bodies of the sick, but is limited to certain localities. This kind of miasm, to which the term 'infection' is sometimes improperly restricted, has a marked period of incubation, which is often a lengthened one. The non-contagious malarious fevers of the West Coast of Africa show an incubation-period of ten to twelve days. In July 1810, our troops in Sicily fell ill with remittent fever thirteen or fourteen days after exposure to malaria. Men continued to fall ill for twelve days after their removal from the infected site. When Irish harvestmen came to our fen districts, they either took ague at the end of their month's work, or not till two or three weeks after their return. Ague may appear months after residence in a marshy district.

18. *Syphilis.*—The induration of a syphilitic sore appears after ten days; six weeks later the rash or sore-throat. The localised changes of the initiatory period may occupy from three days to three weeks or even longer; in the shortest instances with immediate adenopathy the eruption follows in six weeks. John Hunter gives the interval from the local to general infection as two months; this may extend to eighty days. Other constitutional symptoms occur at much longer intervals. The contagion of secondary syphilis requires five weeks or longer to become manifest.

19. *Rabies.* — Hydrophobia presents us with the longest, and also with the most variable period of incubation; this, however, has a limit of great practical value. The shortest interval exceeds a week, so that ill effects felt in a less time than this, or following rapidly after the bite, are readily distinguished from rabies. The usual period of incubation is six weeks. Three weeks is an exceptionally short period, three months not exceptionally long. Dr. Mead gives cases occurring after eleven and fifteen months. A latency of thirteen years has been recorded. After the second month has elapsed, the fear of any ulterior consequences becomes less and less. The incubation of the dumb form of rabies inoculated by M. Pasteur's method in the rabbit is reduced to seven days. In the dog the usual interval is from three to six or eight weeks; it has occurred after three months, and in one instance recorded by Youatt after seven months. The shortest interval given by Regnault, from the bite to signs of rabies in the dog, is ten days; of his sixty-eight cases ten were from a fortnight to three weeks, and fifty-seven at longer intervals up to three months.

The incubation-periods of these widely differing diseases, while retaining distinctive differences, merge into each other. The longest intervals observed for scarlet fever correspond with the shortest observed in measles; yet many diseases are separated widely by their length of incubation, as small-pox from cholera, yellow fever and plague from typhus, and still more widely from the recurrent paludal fevers.

William Squire.

INDIAN RINGWORM.—*See* Epiphytic Skin-Diseases.

INDICATION (*indico*, I point out).—That which suggests or clearly demonstrates the course to be pursued and the remedies to be adopted by the practitioner, either for the prevention or in the actual treatment of disease.

INDIGESTION.—Difficulty in digestion. *See* Digestion, Disorders of.

INDURATED CHANCRE.—A synonym for the initial manifestation of syphilis. *See* Syphilis.

INDURATION (*induro*, I harden).—A term applied to the process or condition of hardening of the tissues from any cause.

INFANTILE CONVULSIONS.—*See* Convulsions; and Infants, Diseases of.

INFANTILE PARALYSIS. — *See* Paralysis, Infantile.

INFANTILE REMITTENT FEVER.—By some authorities a disease thus named has been regarded as a special kind of fever; but the condition is probably either typhoid fever of a mild type, or febrile disturbance accompanying disorders of the alimentary canal.

INFANTS, Diseases of.—There are few disorders which can be said to be peculiar to infancy and childhood. The diseases to which children are liable are, as a rule, those which attack older persons, and present the same pathological characters. But disease as it occurs in children does yet require especial study, for the symptoms by which it is accompanied often differ widely from those with which ordinary hospital practice has rendered us familiar. Children are not merely adults in miniature. They have special peculiarities of constitution, which impress their own stamp upon all acute diseases, and often raise up a number of accessory phenomena which overshadow the main symptoms, and obscure a case which but for them would be simple and clear.

General Characters.—The most striking peculiarity of childhood is the marked excitability of the nervous system; for the promptness and intensity with which the whole system reacts against any source of irritation is a cause of continual embarrassment to the physician. A fragment of indigestible food, for example, may produce high fever, or alarming agitation, and even throw the child into convulsions; a slight irritation of the larynx may produce severe spasm, and simulate for the time all the symptoms of true diphtheritic croup. The beginning of acute disease is almost invariably accompanied by profound general disturbance; but disturbance as profound may be excited by the simplest functional disorder, so that the severity of the symptoms is no guide at all to the severity of the lesion with which we have to deal. In all cases, therefore, it is of importance, if possible, to pick out the local symptoms—those, namely, which point to mischief of any special organ — and separate them from others which are expressive merely of the general distress. Such local symptoms are the cough, rapid breathing, and active nares which point to acute lung-disease; the squinting and immobility of pupils which are so characteristic of cerebral affections; and the peculiar jerking movement of the legs, which, combined with hardness of the abdominal muscles, betrays the existence of colicky pain. Such local symptoms are not, however, always to be discovered, and even if present may not furnish trustworthy indications; for so great is the sympathy in the young child of distant organs with one another—linked together as they are by the impressionable nervous system — that the organ from which the more definite symptoms appear to arise may not be the organ which is actually the seat of disease. The two organs which are most frequently found to present these deceptive manifestations are the stomach and the brain. The sympathy of the stomach with an irritable condition of other parts of the body continues more or less through life: the vomiting of pregnancy and of disordered uterine function in the female, and of cerebral and renal diseases in both sexes, being matter of common observation. In the child, however, this sympathy is carried to its highest point. Vomiting is a common symptom at the beginning of every acute disease, and in many children any casual disturbance is apt to be attended by it. The brain, again, exhibits a close sympathy with irritation of the more important organs. In some cases of pneumonia, notably those in which the inflammation is seated at the apex of the lung, headache, vertigo, delirium, and stupor may be so marked that the ordinary symptoms of the disease are completely obscured, and the case is mistaken for one of meningitis. Again, the violent nocturnal delirium so often excited by the irritation of worms in the alimentary canal, must be within the experience of all.

The nervous excitability of children, and its influence upon the system generally, is well illustrated by the high temperature noticed in many children on the first evening after admission into the wards of a hospital. The elevation varies in degree in different subjects; but if the patient be not a mere infant, it is usually over 100°, although the complaint be one not ordinarily attended by pyrexia.

Perhaps, however, the most familiar instance of the impressibility of the nervous system is seen in the case of convulsions. A 'fit' in the child has a very different meaning to a similar attack in the adult. In the latter it is usually evidence of a grave centric lesion, and its occurrence occasions the greatest anxiety. In the child, on the contrary, it is a common expression of the perturbation of the nervous system, set up in response to some excentric irritation, and often, as in the case of the onset of acute disease, is analogous to the rigor which ushers in an acute attack in older persons. Sometimes, it is true, convulsions are produced in the child, as in the adult, by severe cerebral disease; but in such cases the fits are frequently repeated, and are succeeded by rigidity, paralysis, and other signs of centric irritation. As a rule, single fits, or convulsions occurring without other signs of nerve-lesion in a healthy child, are purely reflex, and have no gravity whatever.

The impressibility of the nervous system is increased by causes which produce a sudden depression of strength, such as a bad attack of diarrhœa, or loss of blood, and in one chronic disease—rickets—the nervous irritability is very great. The effect of chronic wasting upon the child is, however, usually to produce an opposite result; and under the long-continued influence of enfeebling disease the excitability of the nervous system becomes gradually less and less manifest, until it finally disappears almost entirely. It is of importance to the practitioner to bear this fact in mind, for in a child much reduced by chronic illness, the presence of an intercurrent acute complication—such as inflammation of the lung—may be indicated by very few symptoms, the system having become almost insensible to nervous impressions.

Another peculiarity which strikes the attention of anyone accustomed only to disease as it occurs in the adult, is the vast preponderance in infantile disorders of mere disturbance of function, and the disastrous consequences which may ensue from such derangements. Infants rapidly part with their heat, and are easily chilled. They are therefore excessively sensitive to changes of temperature. A catarrh is a common ailment in the young child, and is attended by various dangers according to the part of the mucous tract which is affected by it. Gastric catarrh with violent and repeated vomiting, and intestinal catarrh with uncontrollable diarrhœa, are answerable for a large proportion of the deaths amongst young children during the warmer months. Even in cases where the catarrh affecting the digestive organs is of a less acute and violent character, the issue is often very serious. The gradual failure in nutrition, which is the result of such an impediment to the digestion of food, is a common cause of wasting in young children; and unless measures be taken early to restore the proper working of the alimentary functions, the case may end fatally. In the autumn and winter the bronchial mucous membrane is more frequently attacked. In such cases, however apparently slight may be the catarrh, a weakly infant is always exposed to the danger of pulmonary collapse; and a rapid interference with the respiratory function, such as takes place when collapse of some extent of lung is quickly brought about, is often a cause of sudden death.

It is in consequence of this frequency of functional derangements, and their dangerous character, that *post-mortem* examinations in infants are so often unsatisfactory in not finding any appearances explanatory of the cause of death.

Clinical Examination.—The clinical examination of young children requires tact and patience, but unless the child be very unruly it is not difficult. The patient cannot himself describe his symptoms, but all necessary information can be gained from the parents. Mothers are, as a rule, good observers, and allowing for their natural anxiety and a slight tendency to exaggeration, their statements can usually be relied upon. We can thus learn the previous state of the child, the exact date at which his symptoms began, and the order in which they appeared. Infants should be always stripped for examination, so that the whole body may be exposed to view. Before, however, ordering the removal of the clothes, we should be careful to satisfy ourselves upon certain points which can only be properly observed while the child is in repose. Thus, in order to count the pulse and respiration, perfect quiet is indispensable, for the least movement quickens the heart's action, and alters the rapidity of the breathing. At the same time the temperature can be taken by the thermometer in the rectum. The whole body should then be examined for spots or swellings; the condition of the skin can be noted—whether dry or moist; the fontanelle examined; and we can ascertain the state of the belly, with regard to hardness or softness of the abdominal walls, and the size of the liver and spleen. If the child cry at the time, we mark the character of the voice, for hoarseness is an early sign of congenital syphilis.

In the physical examination of the chest in a child, it is important to attend to the following points: To employ percussion of the two sides at the same period of the respiratory movement, that is, during expiration or during inspiration; to strike gently with *two* fingers, for by this means a larger volume of sound is brought out, and slight dulness is more easily detected; always to use a stethoscope instead of the unassisted ear, in order to limit the area listened to; and to manage so that the child's mouth be open during auscultation, so as to hinder the transmission of sounds from the throat. In an infant the back is best examined by placing the child on the nurse's left shoulder, with his left arm round her neck. If the chin be now depressed by the nurse's hand on the child's head, the muscles of both shoulders are relaxed. The front and sides of the chest can be examined as the infant lies on his back. We must remember that the breath-sounds, especially that of inspiration, are of a more blowing quality in the child than they are in the adult; and that there is naturally less resonance at the right base, on account of the proportionately greater size of the liver.

At the end of the examination the mouth should be looked at for signs of aphthæ or thrush; and the condition of the gums, as to heat and swelling, should be ascertained. Lastly, the throat is to be inspected—depressing the tongue with the handle of a spoon. If there be disorder of the digestive apparatus, such as sickness, constipation, or diarrhœa, it must not be forgotten to examine always and carefully the discharges. The urine should not be overlooked.

Diagnosis.—Diagnosis in the young child is sometimes very difficult, but it is often easy enough. Being aware of the nervous excitability in young subjects, we are prepared for evidences of general disturbance, and look for more special symptoms—such as will indicate local distress, and direct our attention to a particular organ. We are also guided by a history of the attack, as gathered from the mother, and can put our suspicions to the test by a careful exploration of the whole body. In the investigation our general knowledge of the course of disease will be of service. Thus, many disorders have known pathological consequences, and are apt to be followed by special sequelæ. Measles and whooping-cough leave behind them a tendency to catarrhal pneumonia, and a liability to tuberculosis. Scarlatina often leads to acute desquamative nephritis and dropsy. Other diseases, again, encourage particular susceptibilities—as rickets, which renders the body exceptionally sensitive to changes of temperature, and provokes catarrhal derangements. In doubtful cases we must not forget to take prevailing epidemics into account, as the beginning of zymotic disease is often excessively puzzling. In all cases, especially if the patient be an infant, it is important to inquire into the hygienic and dietetic arrangements to which the child is subjected. When we are still undecided, after having exhausted all means of investigation, we must be contented to wait for further indications, and no positive opinion should be hazarded while any doubt remains.

Treatment.—Children, as a rule, respond well to treatment. This may be explained partly by the large proportion of mere functional derangements in the illnesses to which they are subject, and partly by the state of constant change through which the body is passing; growth and development are active in organs, and the tendency is to repair. The term 'treatment,' however, includes far more than the mere giving of physic. A complete change in all the influences acting upon the patient—a reconstruction of the dietary, and a reformation in the hygienic arrangements, especially with regard to air, light, and clothing—will often prove of immense service, and be of far more value than actual drug-giving in furthering the recovery of the child.

In the treatment of acute illness we must remember that young children cannot bear lowering measures; but we must not therefore rush to the opposite extreme, for unless suffering from temporary exhaustion, they are far from being benefited by profuse stimulation. In the beginning of acute inflammatory diseases stimulants are injurious. Even in chronic ailments, such as rickets, where a certain amount of alcohol is often of service, wine should be given with caution, and its effects upon the digestion carefully watched; it can only be given with advantage so long as it improves the appetite, and increases the digestive power.

With regard to medicines little need be said in this place. It may be remarked that, on account of the tendency to acid dyspepsia in all children, alkalis are of especial service; and that they should be always combined with an aromatic, on account of the value of the latter in stimulating the alimentary mucous membrane, and relieving the flatulence and other painful consequences of indigestion. It is important also to remember that children are wonderfully tolerant of certain drugs, while they bear others very badly. Belladonna may be given to infants and children in comparatively large doses. They are also more tolerant of arsenic than their elders. To the action of opium, however, they are excessively susceptible, and the drug should be given—to infants especially—with extreme caution.

Eustace Smith.

INFARCT (*infarcio*, I cram in).—This term was formerly applied to any kind of infiltration of an organ; but its use is now almost confined to the expression *hæmorrhagic infarct*. A hæmorrhagic infarct is a firm, red, usually wedge-shaped patch, which is found in certain organs as the effect of arterial embolism, or, more immediately, of the congestion and extravasation of blood to which the embolism gives rise. *See* Embolism.

INFECTION
INFECTIOUS } (*inficio*, I put in, dye,
INFECTIVE

stain).—There is much ambiguity and want of precision in the application of these terms, and it is only intended here to attempt to define them according to their several uses, the reader being referred for fuller illustration to other appropriate articles, and especially to that on Contagion. Usually, they are coupled with diseases which are known to be capable of transmission from one animal to another of a different class, or from one individual to another of the same species. In general language such diseases are said to be *infectious*, and to be conveyed by *infection*. These words are, however, often employed in a more definite and limited sense, as signifying the transmission of affections of this kind without the necessity of any direct contact between the individuals, or of any obvious application of the morbific agent to the body, or its immediate introduction into the system, this agent being conveyed through the atmosphere, and taken in mainly during the act of respiration. This limited meaning is employed in contradistinction to *contagion* and *contagious*—which then imply direct contact, and to *inoculation*; in this sense some affections being regarded as infectious but not contagious or inoculable, and *vice versâ*. The word *infection* is sometimes used as synonymous with the *contagium* or agent by which a communicable disease is conveyed. An important application of the term *infective* relates to the effects resulting from certain morbid products, such as tubercle, pus, septic materials, &c., which, when introduced into the system by inoculation or in other ways, produce corresponding definite changes by an infective process, manifested by tuberculosis, pyæmia, or septicæmia. When certain morbid conditions have been established within the system, other parts, more or less distant from the primary seat of mischief, often become involved by infection within the body itself —*auto-infection*—in consequence of the infective elements being conveyed by the blood-vessels or lymphatics to these remote parts, and there undergoing further multiplication and growth. Indeed the whole system may thus become tainted, including the blood and other fluids. Illustrations of this signification of infection are afforded by cancer, syphilis, tuberculosis, and suppuration, the last-mentioned not only originating secondary collections of pus, but also setting up pyæmia. *See* CONTAGION.

FREDERICK T. ROBERTS.

INFILTRATION (*in*, into; and *filtro*, I strain through felt).—This term was formerly applied to the effusion of a fluid into the interstices of a tissue, especially connective tissue. Now, however, its meaning has been extended to imply the diffusion of any solid or fluid morbid product in the midst of tissue-elements, such as is seen in calcareous, albuminoid, fatty, and tubercular infiltration. *See* DEGENERATION.

INFLAMMATION (*inflammo*, I set on fire).—SYNON.: Fr. *Inflammation*; Ger. *Entzündung*.

DEFINITION.—Very numerous definitions have been given of inflammation. The most generally received has been that attributed to Celsus, which gives the four marks of inflammation as *rubor*, *tumor*, *calor*, *dolor*; but this appears to have been really due to Erasistratus, who, according to Galen, first gave precision to the conception of simple burning, as understood by the older Greek physicians, and applied the name *φλεγμονή* (previously synonymous with *φλόγωσις*) to a swelling, which had also the characters of heat, pain, throbbing, and resistance. The definition was thus based upon the notion of *swelling*, and would hardly have taken this particular form had it been derived from superficial inflammations. Although the four 'cardinal' signs may still be recognised in what we call inflammation, the definition is best derived from a cause known to be capable of producing it, and we say that *inflammation is a series of changes in a part produced by injury, which may be mechanical, chemical, or physical; provided the damage produced does not entirely destroy the vitality of the part.* When, as generally happens, the injury does destroy the vitality of certain parts, it is only those which just escape destruction which can be said to be inflamed.

In all animals with a complete blood-circulation, injury to any vascular part sets up disturbances of the nervous and vascular mechanism, resulting in hyperæmia, which in slight injuries may be the only visible effect. In severer injuries it always accompanies the other changes, and hence is an integral part of the process. (The changes in non-vascular parts will be afterwards spoken of; those produced by injury in the lower animals need not here be considered.) Bearing this in mind, a gradation may be traced in the effects of injury. A very slight injury to the skin, for instance, by friction, heat, or a chemical irritant, produces transitory hyperæmia; a more severe or more lasting injury sets up inflammation (blister or eczema); one still more intense, necrosis or sloughing. The same gradation may be seen in the after-effects of cold, which, according to its duration or intensity, may lead to mere heat and throbbing, or to inflammation (chilblains or mild frostbite), or to actual gangrene. Even in apparently spontaneous inflammations a cause of injury may always be traced, such, for instance, as a diffusible virus in rheumatic inflammations, or the presence of micro-organisms and their products in infective inflammations, or disturbances of circulation and innervation in the secondary inflammations of circulatory and nervous diseases, or a mere lowered state of nutrition, as in various chronic cachexias. But in most such cases there is a combination of injuries, the presence of some noxious substance coinciding with nervous, vascular, or nutritional disturbance. Hence an inflamed part is always a damaged part, and the state of inflammation may be broadly said to be a state of damage.

Inflammation and Repair.—Since animals are so constructed that injuries short of death always call forth some attempt at repair, we find that along with damage there is always some sign of restoration. The combination of these two factors constitutes inflammation, distinguishing it from necrosis on the one hand, and simple hyperplasia on the other. Accordingly a part of the inflammatory process may be regarded as conservative, tending to compensate the disturbance produced by injury. Hence inflammation often accompanies repair, but can hardly be considered as a necessary part of the latter process. Hunter maintained that inflammation was only a hindrance to healing of wounds, and the results of antiseptic surgery confirm his views. The truth, however, appears to be that in 'clean' or aseptic wounds, however extensive, there is little damage to the tissues. Damage is caused by the secondary injuries resulting from the entrance of bacteria or irritating substances, and when this occurs there is inflammation. In this case the delayed healing which follows cannot be attributed to the original injury, nor, strictly speaking, to inflammation, but to the secondary complications which produced the inflammation, and which this process actually tends to compensate and remove.

In order to exhibit the nature and functions of the several parts of the inflammatory process, we shall consider separately: (1) the vascular processes—hyperæmia and exudation; (2) the changes in the tissues.

1. Direct observation of the vascular processes in inflammation.—When the mesentery or tongue of a frog is drawn out and placed under the microscope, the contact of the air soon determines inflammation; and, by means which need not here be described, both the vessels and the tissue-elements may be observed for hours together. The earliest change seen in the vessels of a part thus exposed is dilatation, first of the arteries, then of the veins, the capillaries being little affected. The dilatation of the vessels is accompanied at first by acceleration of the blood-stream, most noticeable in the arteries; but the acceleration does not last more than half an hour or an hour, and it then gives place to retardation, which continues as long as the inflammation lasts. The 'primary acceleration' is, however, sometimes absent or too short in its duration to be noticeable. So far, the process is doubtless the same as in active hyperæmia produced by local irritation. Whether the first dilatation is due to direct paralysis of the muscular walls of the arteries, or to a reflex action passing through the spinal cord, or to an inhibitory action passing through nerve-ganglia in the arterial walls, is uncertain. There need not, however, be any action connected with the spinal cord, since dilatation may take place when the part is disconnected from the great nerve-centres.

From this point begin the phenomena peculiar to inflammation. The dilatation of arteries may go on increasing for ten or twelve hours, till they have double their original diameter, and pulsation becomes very prominent in them. The capillaries look as if gorged with corpuscles, forming a quasi-solid mass. The blood-current in all the vessels becomes slower and slower, till it is almost stagnant. This condition has been called *stasis*; but it is better to reserve this name for an absolute stagnation, which is no necessary part of inflammation, but is produced in artificial inflammations by local causes, chiefly, probably, by drying up of the tissues. In true inflammation the amount of blood passing through the part is always greatly increased, as may be seen by the fuller current in the veins leading from it. At the same time certain peculiarities are observed in the behaviour of the red corpuscles and leucocytes in the veins. In ordinary conditions of the circulation, the central part only of the vein (as of the artery) is occupied by the corpuscles, which move on mingled together. But during retardation the corpuscles, especially the leucocytes, spread over the marginal portion of the vein usually free from them, and the leucocytes begin to drag along the walls of the vein, as if adherent, till at length they form a layer lining the wall of the vessel, while the red corpuscles are carried on by the current. In the capillaries, this marginal layer is never perfectly established, though leucocytes may be seen momentarily adhering to, or moving slowly along the walls. In the arteries, no such process is observed, except (according to Cohnheim) it may be for a moment during the diastole of the pulse. When this *marginal position* of leucocytes is established, begins the process which, observed long ago by Waller, and less clearly though earlier by William Addison, was re-observed and brought into notice by Cohnheim. In the words of the last-named observer: 'On the outer contour of the wall of a vessel, usually a vein, in which the marginal layer of leucocytes is well developed, sometimes first in a capillary, is seen a small projection which enlarges in length and breadth, and becomes a roundish colourless lump. This again enlarges, puts out new pointed projections, and gradually withdraws itself from the wall of the vessel, till it is attached to it only by a long narrow stem. Finally this attachment also is broken, and we see a colourless contractile body with one long process and several shorter, with one or several nuclei—in fact, a *leucocyte*.' The same process is going on meanwhile at other points of the veins and capillaries, till at length, either quickly or slowly, the outer surface of all the visible veins becomes covered with several rows of leucocytes, while their interior shows the same appearance as before. That the leucocytes seen outside were formerly inside the veins, having simply passed through the walls, admits of no reasonable doubt, though it is often difficult for the eye to seize the precise moment of passage. In the arteries nothing of the kind is seen. In the capillaries the emigration of leucocytes is very evident, and accompanied by the passage of red corpuscles also through the walls, which does not take place in the veins proper. The latter process was observed by Stricker before the revival of the observation of emigration of leucocytes.

Accompanying the extravasation of the blood-corpuscles there is always a copious exudation of fluid, which goes far beyond physiological limits. The fluid also differs from the ordinary physiological transudation and more resembles blood-plasma. Aided by this and by their own spontaneous movements, the leucocytes are carried far and wide into the tissue, till the whole field, that is, the whole mesentery, is so crowded with them that nothing else can be seen. The red corpuscles, on the other hand, remain more closely in the neighbourhood of the vessels. When the exudation, carrying with it the corpuscles, and containing, as it does, coagulable material, reaches the surface, it forms the layer or false membrane of inflammatory lymph, seen in inflammations of serous surfaces. The tissue, at the same time, becomes more or less infiltrated with lymphoid corpuscles, producing the condition known as 'small-celled infiltration.'

Cause of retardation and cell-emigration. The processes just described mark inflammation off sharply from simple hyperæmia. Their production was at one time ascribed to thickening of the blood from transudation of serum; to coagulation in the vessels; to the adhesiveness of leucocytes; and to a change in the tissues external to the vessels. But there is little doubt that the essential factor is a change in the constitution of the vascular wall, though it is possible that this may be connected with a change in the tissues outside, especially with a loss of elasticity, which may be traced in all injured tissues—as may be seen, for instance, in the production of a 'wheal' by a blow on the skin. The same change, while it retards the passage of blood, makes the vascular wall permeable to the corpuscles, and favours exudation. What the change is we cannot say, but it seems probable that it is the same as the walls of vessels undergo when inadequately nourished. Two classes of experiments throw light on this point.

It has been found by Ryneck that other fluids than blood, such as milk, pass with greater difficulty than usual through the vessels of an irritated part; and that stagnation can be produced in the vessels of a frog, which is kept alive by the circulation of salt-solution instead of blood in its vessels. Cohnheim has also shown that a state of the vascular walls similar to that which may be presumed to exist in inflammation, may be produced by shutting off the blood from the vessels for a certain time. He put a ligature round the tongue of a frog, and observed the vessels after the ligature was cut. If the blood had been excluded for twelve to twenty-four hours only, the vessels on the return of the blood passed into a condition of simple hyperæmia; but if longer, stagnation, marginal position of leucocytes, and extravasation of corpuscles were observed, and these phenomena were more marked the longer the ligature had remained, provided it was not long enough entirely to destroy the vitality of the part. From these experiments we must conclude that the cause of the stagnation and its attendant phenomena is not in the blood or the cells, but in the walls of the vessels, and that the change in these is of the nature of degeneration.

2. CHANGES OF THE TISSUE-ELEMENTS.—*Tissue-changes in non-vascular parts.*—The changes of the tissue-elements are most simply seen in non-vascular parts. Alterations in cartilage-cells during ulceration were observed long ago by Goodsir and Redfern, but were not then thought to belong to inflammation, non-vascular parts being not thought liable to this process. Lately the cornea has been taken as the type of non-vascular tissues. If the cornea of a frog be irritated by touching a small spot with nitrate of silver, and cut out within from twelve to twenty-four hours afterwards, many of the fixed corpuscles are found to be already altered. Their processes are become shorter and thicker; their bodies of irregular shape; and they often show amœboid movements, and become converted into many-nucleated protoplasmic masses, resembling what are in some other parts called giant-cells. Finally, in their place may be seen groups of new small or lymphoid cells. But there are always some corneal corpuscles which remain quite unchanged. These changes cannot be traced farther, as the cornea soon becomes turbid, and the whole field of observation crowded with leucocytes.

It is still a matter of dispute whether these changes are truly reproductive or only degenerative; and whether any new cells are really formed from the fixed corpuscles of the cornea, or whether the origin of these leucocytes is the same as of those which are seen surrounding the veins and capillaries of the inflamed mesentery of the frog. Various arguments have been urged, which space forbids us to discuss. The ultimate conclusion appears to be that young cells, indistinguishable from leucocytes or pus-corpuscles, may be formed by a process of growth, cell-division, and germination, affecting the fixed corneal corpuscles, but that the number of these is inconsiderable compared with those which, even in a non-vascular tissue like the cornea, are derived from the vessels.

The process of inflammation in other non-vascular parts, such as cartilage, has been studied in the same way as in the cornea, and the general result is the same.

Tissue-changes in vascular parts.—These, though apparently more ambiguous than in non-vascular parts, are yet sometimes susceptible of more minute study. In the omentum of mammalia, changes occur during inflammation in which unbiassed observation can see nothing else than cell-division, growth, and germination. There is indeed reason to believe that such appearances are found normally, as evidence merely of growth, but the inflammatory changes are distinguished from the normal by their greater frequency and luxuriance. In fibrous connective tissue similar processes have long been observed, and, since attention was drawn to them by Virchow, have been regarded till lately as showing, in the clearest manner, that the fixed cells of the tissue germinate and produce new elements. This 'proliferation of connective tissue' is an obvious fact, but its importance is chiefly, if not entirely, in relation to tissue-formation, and not in the production of lymphoid or pus-cells, often ascribed to it. Around inflamed parts the connective tissue is often found infiltrated with lymphoid cells, the origin of which was formerly set down to proliferation. But it seems more natural to regard this 'small-celled infiltration,' which is a very frequent accompaniment of inflammation, as resulting from migration of leucocytes from the veins and capillaries of the inflamed part. The possibility, however, of the production of some lymphoid cells by proliferation of the fixed elements cannot be actually denied.

There is also reason to believe that the leucocytes emigrated from the vessels may further divide and 'proliferate.' Stricker and Klein have both observed actual cell-division take place under the microscope; so that some of the new cells may be regarded as the descendants of emigrated corpuscles. We may then compare the small or lymphoid cells of inflamed parts to the population of a colony, where most are emigrants, or the descendants of emigrants, but some few trace their descent from the aboriginal inhabitants.

Changes in the tissue-elements: retrograde and progressive.—More important than the infiltration of lymphoid cells are the definite changes which the fixed elements of the tissues undergo. These always show the combination of retrograde or degenerative with progressive or germinative changes, characteristic of inflammation, sometimes the one, sometimes the other, predominating, according to the severity of the injury and the nature of the tissue.

In *connective tissue* the retrograde change consists in swelling and softening of the fibres, which may end in liquefaction, especially when there is suppuration. The progressive changes consist in proliferation and formation of new cells for the purpose of repair. Special histological methods generally permit us to distinguish these elements from migratory lymphoid corpuscles. Nuclear changes, karyokinesis and karyomitosis, may often be traced in inflamed parts by proper methods, and are the most certain evidence of cell-proliferation (*see* CELL). Tissue-repair begins with the formation of so-called epithelioid cells or fibroblasts (fibroplastic cells of the older microscopists), which sometimes enlarge into giant-cells. (The theory of Ziegler, that such cells may be formed out of leucocytes, is now given up by its author.) The nuclei of these cells become the nuclei of the new tissue-elements, the fibres of which are probably formed by splitting up of the protoplasm of the cells. Outgrowths from the surrounding blood-vessels run into the new tissue and vascularise it. The whole process is thus one of continuous growth, quite independent of the migratory lymphoid cells, and of the hyperæmia and exudation, except in so far that the latter help by affording a more abundant supply of nourishment. The relation of the lymphoid cells to repair is thus very obscure, and it is possible that they may be merely a hindrance; though the notion has been started that they serve as pabulum to the growing tissue-cells. But they perform one important function, that of removing injurious foreign particles from the seat of inflammation. Molecules of fat, pigment-granules, and other *débris* of tissue, may be clearly seen to be taken up by them; and there is reason to believe that they also carry away bacteria. Whether their action on these organisms is precisely that which Metschnikoff calls *phagocytosis* is a disputed question, the discussion of which hardly belongs here. *See* IMMUNITY; and PHAGOCYTOSIS.

Muscular tissue becomes granular and loses its striation under the influence of inflammation, and sometimes undergoes another peculiar form of degeneration. But at the same time the muscle-nuclei (unless the tissue be absolutely killed) show signs of growth and proliferation, by which in the end new fibres are produced and the tissue regenerated.

Nerve-fibres undergo rapid disintegration when inflamed; but the nuclei preserve their vitality, and are capable of producing new nerve-tubes, as is seen after section of nerves.

Ganglionic nervous tissue never shows any signs of regeneration after being inflamed, and is probably killed by comparatively slight and transient inflammations, though this tissue is very rarely thus affected.

Epithelium on mucous surfaces shows very characteristic changes. A large number of elements die and are shed off, so that the desquamation of epithelium is far more rapid than under normal conditions. Many cells show excessive mucous transformation and —in chronic inflammations—much fatty degeneration. There is also a copious formation of new epithelial cells, produced, as in normal conditions, apparently from the basement membrane.

Glandular epithelium, when inflamed, shows the characteristic change called granular degeneration or cloudy swelling (*see* DEGENERATION), which has been also called parenchymatous inflammation, and is evidence of the simplest kind of injury to the cells. Severer injuries cause fatty degeneration and breaking down, as seen in various kinds of poisoning. There is probably always a regeneration of gland-cells, but this is often traced with great difficulty.

The above are the tissue-changes usually met with in ordinary inflammations. When the inflammation takes the form of *suppuration*, destruction of tissue is far more complete, and repair is prevented, at least temporarily.

We must now consider the products and results of inflammation, without further distinguishing between the share of the vessels and of the tissues.

PRODUCTS AND RESULTS.—All inflammatory products result either from exudation (with or without participation of the tissues) or from new-growth. The exudative products are serum, mucus, and fibrin, the latter of which, in combination with leucocytes, forms the so-called 'inflammatory lymph.' New-growth takes place from the vessels in the form of vascular connective tissue, of which a special form are granulations. With regard to exudations, no clear line can be drawn, at any stage of the process, between serous and fibrinous exudation or inflammatory lymph. But the production of pus seems to require some special irritant or morbid factor.

Exudations.—Serous and mucous exudations can only be regarded as products of inflammation when excessive. The fluids formed in inflammations of serous cavities differ from those produced in passive exudations (or dropsies), in containing more fibrin and more albumen. But inflammatory exudations vary in this respect, and are sometimes scarcely to be distinguished from simple serous effusions. The fluids poured out on serous surfaces in acute inflammation always coagulate, and even in chronic cases can often be shown to be capable of coagulation. On mucous surfaces, on the contrary, the exudation does not as a rule coagulate. That this is owing in some way to the action of the epithelium seems most probable, whether it is that filtration through epithelium alters the composition of the fluid, or whether the living epithelium prevents coagulation in the same way as the endothelium of the vessels prevents coagulation of the circulating blood. When, however, the epithelium is removed, a fibrinous layer may be produced on the exposed sub-mucous surface; and the same result seems to follow the application of very powerful irritants, as in croupous inflammations. Mucous exudations contain mucin, as well as serum-albumen, in variable proportions.

Fibrinous exudations, in coagulating, entangle whatever leucocytes may be either extruded with the exudation or present in the tissues. The properties of the coagulated mass differ according to the proportion of corpuscles. These differences do not necessarily show any corresponding differences in the composition of the blood, but depend upon the facility with which the corpuscles leave the vessels, and probably on the state of nutrition of the latter. The product called *inflammatory lymph* consists of coagulated fibrin entangling leucocytes, the two constituents being in varying proportions. The fibrin does not differ from that of blood-clot; and may therefore be formed in the same way by a reaction between the exuded constituents of blood. But it is not a constant product of inflammation, and hence has been thought to owe its production to local causes—that is, to reaction between the tissues and the exudation. Thus fibrin is formed on serous surfaces where one of the fibrin constituents is normally found, and in fibrous tissue where there are similar chemical constituents; but, as stated above, not generally on inflamed mucous surfaces, or in epithelial structures. But since it is possible that in these cases the exudation becomes altered by filtration through the tissues, there is no reason to doubt that fibrin, or both its chemical constituents, may be exuded from the vessels. The inflammatory fibrin itself is never *organised*, but often becomes *replaced* by a vascular connective tissue which grows into it, and causes its absorption. This is the process formerly spoken of as organisation of lymph.

Pus.—Pus is inflammatory exudation in which the corpuscles greatly predominate, and the intermediate substance is liquid. It is thus difficult to draw a line between pus and softer forms of inflammatory lymph, but the former does not contain fibrin, nor does it coagulate spontaneously. The following analysis of pus may be taken as representing an average specimen:—

Water	887·6
Pus-cells and mucus . .	46·5
Albumen	43·8
Fat and cholesterin . .	10·9
Sodium-chloride . . .	5·9
Other alkaline salts . .	3·2
Earthy phosphates and iron .	2·1
	1000·0

It is noticeable that pus contains a much larger proportion of fat than any other inflammatory product, or than blood. Its specific gravity is 1030 to 1033. The appearance of pus is well known: it is a creamy fluid, which, when normal or 'laudable' and fresh, has a very faint—not offensive—odour, and no sign of putrefaction. Under certain circumstances, it has a strong ammoniacal or putrefactive odour, and is described as 'unhealthy,' or sanious. When allowed to stand, all pus separates into a liquid portion or 'serum,' and a sediment consisting chiefly of the corpuscles. The serum resembles blood-serum, containing paraglobulin or fibrino-plastic substance, potassium-albuminate (or casein), ordinary serum-albumen, and myosin. Other constituents of pus are protagon, chondrin, gelatin, leucin, tyrosin, and xanthin.

Pus-corpuscles.—The corpuscles of fresh, newly formed pus, as seen, for instance, on an inflamed mucous surface, are not distinguishable from leucocytes of the blood, showing active amœboid movements and continual change of form. Most corpuscles from large collections of pus, such as abscesses, are already dead, being nearly spherical in form, with the appearance of a cell-wall, and showing when acted upon by acetic acid three or more small nuclei.

Causes of suppuration.—While the production of individual pus-corpuscles is to be explained in the same way as that of inflammatory cells in general, there are good reasons for thinking that the formation of pus requires, in addition, some more special cause.

The most important cause is undoubtedly the presence of bacteria, especially certain species of micrococci, which are almost always present in collections of pus, large or small; sometimes contained in the pus-corpuscles, sometimes free in the liquid. Ogston found micrococci in every one of 74 abscesses not previously opened; and they can be found, broadly speaking, in all boils, pustules, and the like. The commonest species are Staphylococcus pyogenes albus and S. aureus, with sometimes Streptococcus pyogenes. The latter is the characteristic form in internal suppurations, especially in pyæmia. There can be no doubt that these micrococci produce suppuration, since, when cultivated, they have often been made to produce furuncles and abscesses when rubbed firmly or inoculated into the human skin, even more constantly and certainly than in the case of experimental animals. Since these micrococci are often found (by cultivation) to be present in certain parts of the healthy human skin, as well as widely spread in human dwellings, there must be some favouring circumstances or contributory causes which enable them thus to injure the tissues. Such favouring circumstances are (1) some previous lesion of the tissues; (2) special conditions, especially bad nutrition, the tenderness of tissue in children, and perhaps idiosyncrasy; (3) certain states of the blood, especially the presence of special substances, such as glucose, and probably ptomaïnes or enzymes, absorbed from the intestines. Animal parasites, such as hydatids, appear to produce suppuration by their direct action, without the assistance of bacteria.

In the absence of micrococci, suppuration may be produced by other agents; which may also act as contributory causes with the bacteria. Such are turpentine, croton oil, carbolic acid, ammonia, strong solutions of perchloride of mercury, &c.; several of which are powerful bactericides. In addition, the same result has been produced experimentally by sterilised solutions of certain bacterial products, as albumoses and ptomaïnes, *e.g.* cadaverine; and certain enzymes, *e.g.* the vegetable ferment of jequirity; and doubtless others will be found to have the same effect. It thus appears that chemical substances having powerful solvent or necrotic action on tissues produce suppuration, and do so apparently by softening the walls of the blood-vessels and favouring emigration of leucocytes—which will be mostly dead. The action of micrococci is to be explained in the same way, these organisms producing enzymes which peptonise and thus soften or dissolve the walls of the blood-vessels. The well-known destructive or solvent action of pus is also thus accounted for. Micrococci are doubtless the cause of almost all suppurations, since the other agents mentioned will not be present unless experimentally introduced. The bearing of these conclusions upon antiseptic surgery, which has supplied much of the evidence on which they are based, is obvious. We gain also by this knowledge an adequate explanation of the infectivity of pus; as seen in contagious impetigo of the skin, conjunctivitis, urethritis, &c.

Granulation-Tissue.—When a part has been destroyed by inflammation, the lost tissue is replaced by the preliminary formation of a peculiar structure, consisting of a highly vascular connective-tissue framework, containing an excessive number of leucocytes, and also epithelioid or formative cells, with occasional giant-cells. The vessels are of delicate structure, and easily lacerated. This tissue also contains nerves. It has been compared to the cellular structure which composes the embryo, or to *embryonic* tissue, but the great predominance of vessels constitutes an important difference. Such tissue always originates as an outgrowth of the vessels of the inflamed part; it grows into regular connective tissue, and is thus the most important means of replacing the tissue destroyed. When produced on a surface, and growing out in the form of tufts, it receives the name of *granulations*; and, as is well known, ulcers and cavities become filled up by it. There is no doubt that granulation-tissue may form fibrous tissue, but not epithelial structures or any specialised tissue. The formation of granulations is not necessary to the repair of wounds; and their persistence is evidently a sign of delayed repair; hence some have regarded their formation as antagonistic to healing. Hamilton has ingeniously shown that granulations are, or may be, produced by outward dilatation of capillaries not restrained by the integument.

VARIETIES.—The most striking differences between different kinds of inflammation are those depending upon the differences of tissues, and of the situations in which it occurs.

1. *Catarrhal.*—On mucous membranes the exudation is mucous, does not coagulate, and contains only detached epithelial cells, with scattered leucocytes; the process tends to become chronic; but the effect on the body as a whole is less marked than in other forms. This is *catarrhal* inflammation, a term which is with less propriety transferred to inflammations of the skin, the lung, and some glandular organs.

If catarrhal inflammation is very severe it becomes purulent, and the exudation consists chiefly of pus, little or no mucus being produced. This purulent catarrh is especially characteristic of specific inflammations of the mucous surfaces, such as virulent conjunctivitis or gonorrhœa.

2. *Croupous or fibrinous.—Croupous* inflammation is that form in which a coagulable exudation is formed upon a mucous surface. In diphtheritic inflammation there is, besides a membranous exudation, some necrosis of the mucous membrane. In these forms the tendency is to acute, not chronic, disease; and the general symptoms are strongly marked. The name 'croup' has also been transferred to certain inflammations of the lung ('croupous pneumonia') and of the kidney, but (in the latter case especially) with doubtful propriety.

The *fibrinous* form may be regarded as the normal or usual form of inflammation of serous membranes and fibrous connective tissue.

On serous surfaces the lowest degree of inflammation is seen in a serous exudation, containing little or no plasma, hardly to be distinguished from simple dropsy; but there is no clear line between this and a coagulable exudation, or fibrinous inflammation. This too, if still more severe, may become purulent; and, as we see in the pericardium or pleura, a purulent may succeed to a fibrinous inflammation. Finally, vascular connective tissue, forming adhesions, is generally produced. In areolar connective tissue, and in the interstitial tissue of various organs, the same stages may be distinguished, known as *inflammatory œdema*, which occurs near a focus of acute inflammation; *inflammatory hardening*, such as precedes the formation of an abscess; and, finally, either abscess itself or purulent infiltration—the two forms of suppuration in connective tissue.

3. *Parenchymatous.*—It is not so easy to define the kinds of inflammation as affecting the special elements or parenchyma of organs. The lung appears to be an exception to the general rule that epithelial surfaces show the catarrhal form of inflammation, since lobar pneumonia is a type of the fibrinous form; but it should be remembered that the anatomical structure of the air-vesicles more resembles a serous than a mucous surface, having only a single layer of epithelium; and that mechanical injury to the lung always produces a catarrhal form of inflammation.

The name 'parenchymatous inflammation' has been given to those changes occurring in the special tissues of organs independent of their connective-tissue framework. The only factor common to all such appears to be a granular degeneration of the protoplasm of their cells, identical with what is elsewhere called albuminous degeneration, though it may end in fatty or other degeneration. In contradistinction to this, inflammation of the connective-tissue framework is termed *interstitial inflammation.*

4. *Phlegmonous.*—Phlegmonous inflammation is the same as *acute interstitial inflammation*, ending in the formation of abscess.

5. *Indurative.*—Indurative inflammation is that in which new connective tissue is produced in the interior of organs. This is *chronic interstitial inflammation.*

6. *Scrofulous.*—Scrofulous inflammation is that type which occurs in cachectic persons, whose tissues are easily injured and heal slowly. Such persons are subject to chronic inflammations, which, further, involve destruction of tissue, and in which the inflammatory products readily undergo degeneration; unless these characters of destruction and degeneration are present, the name 'scrofulous' has no precise meaning. There can be little doubt that all scrofulous inflammations are really tubercular. *Strumous* is a word better forgotten, being synonymous with scrofulous, and liable to be misunderstood.

7. *Infective.*—Infective inflammations are those produced by the passage into the blood of infective matter, derived from some previously existing inflammation. Pyæmia and inflammations associated with the puerperal state are instances.

8. *Chronic.*—Most inflammations have at first a typical course, reaching their acme and then declining. If the decline is not followed by resolution they become chronic. Others, again, show from the first the character they all along maintain. Chronic inflammations are usually distinguished by the

persistence of that condition of the vessels which permits exudation and cell-emigration, with less hyperæmia and general fever than in the acute form. On mucous surfaces the chronic form differs little from the acute, except in these two respects. In serous membranes chronic inflammation produces fibrous adhesions, with little or no liquid exudation. In the interstitial tissue of solid organs a large amount of new connective tissue is produced by chronic inflammation, which first compresses the special elements, causing them to waste, and then contracts in bulk, so that the organ becomes atrophied, and usually harder and more fibrous. This is the process called 'fibroid degeneration,' as in cirrhosis of the liver. 'Chronic parenchymatous inflammations' are simple degenerations, as seen in the kidney.

TERMINATIONS.—The most favourable termination of inflammation is what is called *resolution*, in which the vascular phenomena and tissue-changes decline together, and pass away without leaving any tangible material result. Even in the apparently most perfect cases of resolution, there is little doubt that products of exudation remain when the vascular changes have subsided, and are slowly removed by the lymphatics. Other so-called terminations are *necrosis*, or total death of the part; and partial destruction by suppuration or *ulceration*. But if any loss of substance occurs, the inflammatory process cannot be regarded as at an end till the loss is wholly or partially restored by newly formed connective tissue. Where there is no destruction of tissue, but only masses of liquid or solid exudation, the inflammation is not, strictly speaking, resolved till these are removed. Very frequently an acute passes into a chronic inflammation.

CONSEQUENCES.—1. *Local consequences.*—If an inflamed part does not simply return to its original state, *atrophy* is the most common consequence. *Hypertrophy* can hardly be said to occur in the part actually inflamed, though it may in adjoining parts, as we see in enlargement of bone from periostitis. False hypertrophy from new formation of connective tissue is common; but, as such tissue contracts, the final result is atrophy. The hardness of this tissue causes *induration* to be put down among the consequences of inflammation.

2. *General consequences.*—The effect of inflammation on the whole body is to produce the condition of *fever*, which is discussed in another part of this work. It will suffice here to say that fever involves raising of the body-temperature, weakening and acceleration of the heart, and disturbance of the nervous system, as well as of all the nutritive processes. It was formerly supposed that local inflammation produced fever simply through the increased production of heat by more rapid tissue-change in the inflamed part; this process raising the temperature of the blood passing through the part, and thus of the whole body by means of the blood. But this simple explanation is not adequate. It has even been much disputed whether the heat of inflamed parts ever surpasses that of the blood, though the temperature of inflamed external parts is higher than the normal in that situation, and than that of a corresponding part, not inflamed, on the other side of the body. But this is also the case in hyperæmia, in which condition the external temperature never surpasses that of internal organs. Experiments on inflammation have led to very conflicting results: those of Simon and Weber being directly opposite to those of Jacobson and others. But even if we assume an actual production of heat in inflamed parts, this will not be enough, as is shown by calculation, to account for the rise of temperature in the whole body. It has also been supposed that some fever-producing or *pyrogenic* substance passes into the blood from every inflamed part, and causes increased tissue-change, with consequent increased production of heat through the whole body; or else exerts a special action on the heat-centres. Several substances having a pyrogenic property have been isolated. They are either animal ferments (enzymes) or albumoses, produced by the action of bacteria on proteid substances. Finally, it is held that the nervous system has a large, or even the chief, share in the production of fever; the inflamed part acting through the nerves on the cerebral heat-centres controlling the temperature of the body. But none of these theories is definitely established, and the manner, therefore, in which local inflammation produces fever is not yet perfectly understood. The degree in which local inflammations cause fever varies, and does not appear to depend wholly on the mass or the intensity of the inflammation, though both these conditions are partly concerned. Acute inflammations produce more fever than chronic: those of connective-tissue more than those of mucous surfaces; and, most of all, those which end in suppuration. In infective inflammations the fever is generally high, but not to be attributed to the local inflammation, being a concurrent effect of the same cause—the infective poison. Besides general fever, the special condition called *pyæmia*, in which other local inflammations result, may be a consequence of primary inflammation; but only when certain special causes are at work. *See* FEVER; and PYÆMIA.

ÆTIOLOGY.—Most inflammations are caused by some injury—either mechanical, as by actual violence; or physical, as changes of temperature; or chemical, by powerfully acting substances, as acids, alkalis, and many more. A most important secondary factor is the condition of the body, whether under- or over-nourished, or in some other way wrong; and this may probably be still more closely defined as the condition of the blood-vessels. Many parts of the body, as the skin and the stomach, are constantly exposed to injury, but do not become inflamed unless from some internal cause; and, therefore, a change of nutrition may be the apparent or immediate cause. It is also clear that certain inflammations, as herpes zoster, are determined by disturbance of the nerves; and it is very probable that similar nervous disturbances cause other local inflammations. Besides these, there are certain specific causes, namely, infective or specific poisons, which, when introduced into the blood, produce local inflammations. Many local inflammations, external and internal, appear to arise spontaneously, neither irritation nor fault of nutrition being easily traced. But in these, as in others, it is probable that some infective cause is at work, or else that there is a gradual accumulation in the blood of some irritant substance, the effects of which are only seen when the nutrition of the part is lowered. Such, for instance, are the secondary inflammations which occur in chronic diseases, as morbus Brightii. It is also probable, and in some cases proved, that other inflammations which were at one time thought spontaneous, are really secondary, depending upon some previous local inflammation, even without what is called actual pyæmia. Thus the number of such apparently spontaneous inflammations is gradually lessening.

Treatment.—We shall divide this subject into the treatment of *directly accessible* (chiefly external) inflammations; and that of *indirectly accessible* (internal) inflammations. Treatment will also differ according as the inflammation is acute or chronic; according to the stage, if acute; and also according to the constitution of the patient.

(*a*) *Directly accessible.*—Directly accessible inflammation in an early stage may be treated by local blood-letting, and by astringents. The benefit of local blood-letting in an early stage is undoubted, and is probably due to its relieving the condition of stagnation, and permitting freer circulation of blood in the part. Of astringents the type is *cold.* When the vascular disturbance, that is, hyperæmia, is great, and the general fever high, cold, produced either by ice or evaporation, is generally the best treatment. In the case of mechanical injuries, for instance, it may be regarded as an ascertained fact that if any injured part be kept cold during the period of reaction, the inflammation is less severe. When the condition of inflammatory exudation is set up, the effect of cold is less marked; and if a temporary benefit is produced, the condition after the application of cold is stopped may be as bad as ever, or perhaps worse. The defect of cold as an antiphlogistic seems to be that, though it reduces hyperæmia, and, if sufficiently intense, actually checks inflammation, it does not remove the injured condition of the vessels and tissues on which the profounder inflammatory changes depend. Cold is also a powerful nervous sedative, and reduces the nervous irritability of inflamed parts. It is remarkable that an effect like that of cold is produced by solutions of certain *metallic salts,* especially those of lead, zinc, silver, and bismuth. These salts furnish the most certain and direct means of treating an inflammation in parts actually accessible to their action. Hence they are used in superficial inflammations of the mucous membranes, such as the digestive mucous membrane and the conjunctiva, and of the skin. Their use is limited by the difficulty of bringing them in actual contact with deeper inflamed parts. But Mr. Hutchinson has shown that even in severe injuries the antiphlogistic effect of lead is quite equal to that of cold, if it can be made to pass deeply enough into the injured parts. These mineral (and also vegetable) astringents act more potently on the exudative processes of inflammation than on the vascular disturbance. Hence their activity is most valuable when that of cold ends; and they have a striking effect on chronic inflammations which are unaffected by cold. Even *pressure* may be useful as an astringent, as we see in strapping a testicle or an inflamed joint. In applying all astringents, it is of the first importance to be sure that their effect is actually exerted on the inflamed part. In applying ice to the chest for pneumonia or pericarditis, for instance, this result is very doubtful.

In the treatment of even acute inflammations, the precisely opposite application, that of *heat,* is sometimes valuable. Hot and cold have respectively always had their partisans, and have been, the writer thinks, needlessly opposed. There are instances (such as the cure of a whitlow by plunging the finger into very hot water) where the sudden application of heat seems to cut an inflammation short. Probably this is only when the cause is some infective micro-organism. Short of this, heat doubtless increases the activity of most inflammatory processes. But heat combined with *moisture* is the type of an *emollient,* by which the substance of inflamed tissues is relaxed, the blood-vessels dilated, the sense of tension and nervous irritation removed; and though exudative processes are probably encouraged, the *mechanical* condition of inflammatory stagnation is relieved, and resolution is thus hastened. When pus is forming, there is little doubt that heat and moisture (in the form of poultices and fomentations) hasten the process, and increase the amount of pus formed; but since the increased production of pus is of no consequence, and it is more important to hasten the process, this may be the right treatment for suppuration. When pus is once formed, the same treatment is useful in guiding it in the direction in which it is least hurtful. Finally, it may be beneficial to apply heat and moisture superficially, to relieve deep-seated organs, by stimulating the vascular and lymphatic circulation through the skin. Thus, in applying poultices for pneumonia we do not make the lung or even the pleura hotter, but relieve the overloaded blood-vessels and lymphatics.

Further, in treating all superficial inflammations we must guard against anything which increases the injury, such as movement, further irritation by the air, or by anything contained in the air. Thus, in some skin-diseases, as herpes zoster, secondary inflammation is prevented by an artificial covering of collodion. Antiseptic surgery shows that not the air, but bacteria conveyed by the air or otherwise, are to be feared, and if these are excluded much inflammation is prevented. The benefits of mechanical rest in treating injuries of the limbs need not be more than mentioned; nor that of physiological rest, wherever it can be obtained, in threatened or existing inflammation of any active organ whatever—for example, the brain, the stomach, or the kidney.

In many acute inflammations, however, where we know the course of the inflammation, and that we cannot absolutely stop the process, our best method may be merely to apply palliatives, that is, to adopt an *expectant method.*

Diet is also of great importance. There is little doubt that the intensity of all inflammations is lessened by greatly diminishing the food taken. In some acute inflammations, especially fevers, we may pursue a different system, with the view of saving the patient's strength; but it is possible that in the reaction against the starving process, 'the feeding of fevers' may be in the present day sometimes carried too far.

In the treatment of *chronic inflammation* in accessible parts, the first aim will be to check the exudation and cell-migration, that is, to bring the vascular wall into a healthy state. Here we find that metallic and vegetable astringents are most useful. But it may, with the same object, be well to draw more blood into the part, in order that the vascular wall may be better nourished. This is effected by *stimulants*, which are of well-known efficacy in chronic inflammation. Some of these agents are the same as astringents, but in a more concentrated form—nitrate of silver, sulphate of copper, &c.; others, like iodine and cantharides, are irritants. The local action of certain substances which may be called *aromatics* in healing some kinds of chronic inflammation is most remarkable. Thus, tar, either from wood or from coal, and similar bodies are used in chronic inflammations of the skin; copaiba, cubebs, sandal-wood, &c., when excreted by the urine, act beneficially in chronic cystitis and urethritis. Benzoin, the tars, copaiba, tolu, and many other aromatic and resinous compounds, when excreted by the lungs, act in the same way on chronic bronchitis. The *rationale* of the action of these drugs is difficult to understand, but they are all oxidisable substances which undergo slow oxidation in the air, often accompanied by an ozonising action. Again, it may happen that it is best to sweep the old tissue away, and allow new vessels to be formed, which will probably have healthier walls. This is effected by destructive *caustics*, as nitrate of silver, potassa fusa, chloride of zinc, or even the actual cautery.

In chronic inflammations, internal treatment is often of great service, as we shall presently show.

(*b*) *Indirectly accessible.*—The treatment of indirectly accessible inflammations, or, what amounts to the same thing, the treatment by internal (general) methods even of directly accessible inflammations, is much less satisfactory than the local.

The first indication is to give the part actual rest, mechanical or physiological. The next is to consider if there is any way of reducing the intensity either of the local reaction, or of the fever. Of such means the chief are general blood-letting; the general application of cold; and certain particular drugs, such as mercurials, antimonials, purgatives, digitalis, aconite, quinine, and a number more.

Of *general blood-letting* we cannot say much here. There can be little doubt that it often lowers the energy of inflammatory processes in an early stage. If it has gone out of use, it is probably because the course of many diseases is now better known, and we do not expect to cut them short; because the list of infective diseases is enlarged; and because the benefits are believed to be outweighed by the supposed drawbacks in diminishing the strength of the patient. Of *cold baths* we need only here say that they are far more potent in checking the condition of fever than in stopping local inflammation. Of *drugs*, digitalis is supposed to act by depressing the heart's action; but in theory this is doubtful, and in practice we see little effect on organic inflammations. Aconite also has little local effect, but does modify the febrile state. Quinine is thought, on theoretical and experimental grounds, to check the emigration of leucocytes, and to kill the pathogenic bacteria. The first belief is experimentally true, if the drug is in a certain degree of concentration; but we have no safe means of introducing it, in this degree of concentration, into the blood. The second is extremely doubtful. Alcohol even has been recommended as an antiphlogistic, on the ground that it lowers the temperature in health. But even this is not constant, and there is no good reason for thinking that it has this effect in fevers, still less that it checks the inflammatory process. If alcohol be given, it must be on other grounds. Salicylic acid, carbolic acid, and thymol are lauded as destroying micro-organisms; but, as with quinine, we cannot get them into the blood in sufficient concentration, and, if we could, it is probable that other more serious disturbances would be produced.

The conclusion must be that there is no one drug which is capable of controlling local processes of inflammation, though the resulting condition of fever may be modified.

The use of mercurials and antimonials seems to have been affected by the same considerations as blood-letting. The action formerly attributed to them is now doubted, probably on very insufficient grounds, and it is further thought they do harm in other ways. But no adequate explanation has been given of the difference in this respect between the practice of this and the last generation. Purgatives remain as a harmless, unquestionable, but not very potent antiphlogistic method.

In the general treatment of *chronic* inflammations we have more satisfactory principles. Chronic inflammation is, in other words, *imperfect repair.* It is in cachectic persons, or persons with an inherited proclivity (perhaps not yet manifest) to cachectic diseases, that inflammations most tend to become chronic. Hence, the first rule is to improve the nutrition. Many patients with chronic inflammations get well at once when placed in good quarters, and on good food, provided that the digestive functions are first attended to. Next in importance come nutrient tonics, of which cod-liver oil is the chief. There are few chronic inflammations in which it does not do good. Iron is very often valuable; and, if it fails or is contra-indicated, arsenic may be employed. In chronic inflammations of fibrous tissues, iodide of potassium has a real value, not easily explained. In treating other inflammations, either acute or chronic, there are many specific remedies, but these are remedies for the disease, not for its inflammatory features only. For this reason, we do not here speak of mercury, colchicum, salicylate of sodium, and other agents.

Finally, a most important means of treating indirectly accessible inflammations must be mentioned, namely, that by *counter-irritants,* or setting up a rival inflammation. In order to relieve an inflammation, for instance, of the knee-joint, we produce a superficial inflammation of the skin. This is most used in chronic, but applies to some acute inflammations also. Various explanations have been given of the undoubted efficacy of this treatment. Some believe the action is transmitted through the nerves; others that blood is drawn away; others that the lymphatics are stimulated. The writer's belief is that in the most marked cases of benefit from counter-irritation there is a continuity of the tissue between the inflamed organ and the part where the counter-irritant is applied, and that the action may sometimes consist in drawing away blood; but more generally the benefit results from setting up currents of plasma through the lymphatics and the connective-tissue spaces. It should be noted that in some inflammations where œdema is a marked feature (*e.g.* epididymitis), simple puncture has an unquestionable efficacy which may perhaps be explained in the same way. The substances used for counter-irritation are either vesicants or rubefacients, such as cantharides, ammonia, mustard, or iodine. Dry heat at different temperatures may produce the effect of either of these classes. When redness is produced on the skin, it does not follow that hyperæmia alone results. In fact, the desquamation often shows that a low form of inflammation has been established.

The writer has here endeavoured to give only the principles of the treatment of inflammation. For the treatment of inflammations of special parts, the articles on these subjects must be consulted, as well as the articles on BLOOD, Abstraction of; COUNTER-IRRITANTS; and HEAT, Therapeutics of.

J. F. PAYNE.

INFLATION (*inflo*, I blow into).—A term applied, therapeutically, to the method of blowing air or gas into any hollow space. It is employed particularly in connexion with the lungs in the process of artificial respiration (*see* ARTIFICIAL RESPIRATION). It is also used for the purpose of dilating the bowel in cases of obstruction (*see* INTESTINAL OBSTRUCTION). The term 'inflation' was formerly used, pathologically, as a synonym for emphysema of the lungs, but is now more strictly limited to the condition in which the alveoli are temporarily distended with air, from any obstruction in the air-passages. *See* LUNGS, Emphysema of.

INFLUENZA.[1]—SYNON.: Epidemic Catarrh; Fr. *Grippe*; Ger. *Influenza*; *Epidemischer Schnupfenfieber.*

The term 'influenza' is said to have been first introduced in 1741, when the disease was prevailing in the North of Italy, and it has been generally adopted in this country; though the more scientific term—'epidemic catarrhal fever'—is often used in systematic works.

DEFINITION.—This disease is not to be regarded as simply an unusually prevalent common catarrh, but must be considered as a specific affection, which appears occasionally over wide districts, and at or about the same time; is characterised by marked febrile symptoms; is often attended by serious complications; and causes great and prolonged prostration of strength.

---

[1] This article appears in its original form as written by the late Dr. Peacock. It is followed by a supplement which brings the subject down to the present time.—EDITOR.

Occurrence.—Various epidemics of influenza are on record from the middle ages down to more recent times, and those which have occurred in the last and present centuries have been fully described. The disease is reported to have prevailed in 1729, 1732–33, 1737, 1742, 1758, 1762, 1767, 1775, and 1782, and in 1803, 1833, 1837, and 1847. The following account is chiefly founded upon the disease as it prevailed in 1847; but the description given of its peculiarities corresponds with the accounts of previous epidemics.

Forms.—Influenza may be described as assuming three distinct forms:—

1. That in which it is *simple*, or unattended with any serious complication.

2. When it is *complicated* with serious pulmonary affections, especially bronchitis and pneumonia.

3. When the *disorder of the digestive organs*, which generally exists to some degree in the disease, becomes a more prominent feature; while there are at the same time marked rheumatic symptoms, and the complaint shows a tendency to assume a remittent form.

The description would also be imperfect without reference being made to the *modifying influence* which the epidemic exerts *over other diseases* prevailing at the same time, and especially over the specific fevers.

1. Simple Catarrhal Fever.—In this form of the disease the attack is most commonly sudden. The patient experiences a sense of cold down the back and between the shoulders, lapsing into general chilliness or complete rigors, and succeeded by flushes of heat and dryness of the skin, pain in the head, chest, and extremities, and prostration of strength. Generally these symptoms follow some exposure to cold and damp, but occasionally they appear without being traceable to any immediately exciting cause, and more rarely the attack comes on gradually, with a general feeling of indisposition of two or three days' duration.

At first there is dryness of the nostrils and soreness of the throat, with a sense of tightness or constriction of the chest, and a dry, hard cough. As the disease advances, copious defluxion from the nostrils takes place; the throat is often seriously affected; and the cough is more frequent. The expectoration is at first scanty, and consists of a pale glairy fluid; but at a later period there is more copious discharge of opaque mucus. At the same time some degree of difficulty of breathing and soreness at the chest are experienced. The respiration is in most instances accelerated; and, on auscultation, the inspiratory sounds are dry and harsh, especially in the posterior and inferior parts of the chest; and sibilant and sonorous rhonchi may be audible on forced inspiration. In some cases no marked sounds are heard, but the vesicular murmur is very indistinct. A sense of chilliness, alternating with flushes of heat, is a general symptom throughout the progress of the attack; and there is distressing headache, particularly in the forehead, across one or both eyebrows, as well as pain in the balls of the eyes. These symptoms often undergo considerable remission during the day. There is also commonly much mental depression and nocturnal restlessness. The tongue is usually moist, and covered with a white creamy fur; but occasionally it is morbidly red at the tip and edges, and thickly coated with a whity-brown fur towards the centre and root; more rarely, and especially in the morning, it is dry. In the greater number of cases, entire loss of appetite, with some nausea, and a confined state of the bowels, are present from the commencement; but occasionally diarrhœa is observed at an early period, and not infrequently it comes on during the progress of the disease. Sense of weight, tenderness, and pain in the right hypochondrium are frequently experienced; and there is often some icteroid tinging of the conjunctivæ, or of the general complexion. The urine is scanty and high-coloured at first, but subsequently becomes more free, and deposits some sediment.

Prostration of strength is throughout one of the most marked and distressing features of the complaint, and there is a general feeling of soreness, with dull aching pains in the chest, back, and limbs. The pulse is but little varied in frequency, generally ranging from 80 to 90, and rarely exceeding 100. Though occasionally full, it is uniformly very compressible, and, after the first day or two, feeble. The skin is seldom hot or very dry, or if so it is only at the commencement of the attack, and it soon becomes cool and moist; the complaint usually subsides with free perspiration.

The ordinary duration is from three to five days in the milder cases, and from seven to ten in the more severe. The disease, however, on its subsidence usually leaves the patient for some time much prostrated, and suffering from loss of appetite, inaptitude for bodily or mental exertion, and a troublesome cough. There is a great tendency to relapse.

Not infrequently towards the termination of the attack the transient pains, which are troublesome during its course, increase in severity, and rheumatic affections of an obstinate and painful character supervene. These often assume a remittent or intermittent form, returning regularly at the same hour for several days in succession, and not infrequently affecting one side of the head, or one eyebrow or eyeball, and occasionally the intercostal muscles of one side.

2. Epidemic Catarrhal Fever with predominant Pulmonary Affection.—Not infrequently the symptoms of implication of the aërial mucous membrane or lungs are more marked, there being decided quinsy, laryngeal symptoms, croup, bronchitis, or pneumonia. Of these the most frequent and important are the bronchitic and pneumonic complications.

Bronchitis.—This has especially the tendency to assume the acute capillary form. In cases of *acute capillary bronchitis* occurring as a complication of influenza, there is usually in the *early* stage increased frequency and some difficulty of breathing, constriction of the chest, and soreness or stiffness of the throat. The cough, though slight, is troublesome from its frequency. The expectoration, if there be any, is scanty and of a glairy character. The tongue is usually red at the tip and edges, and covered on the dorsum with a creamy mucus or with a whity-brown fur; occasionally it is morbidly red throughout. The pulse is accelerated, beating generally 110 to 112 or 116 in the minute, and occasionally more frequently. The skin is not usually hot, except it be at the commencement of the attack, and if so it usually becomes cooler in two or three days. With these symptoms there are the marked prostration of strength, the severe frontal headache, the general soreness of the body, and the pains in the back and limbs, which characterise the ordinary cases of influenza.

When the chest is examined in this stage of the disease, the only morbid signs detected are a roughness of the inspiratory sound, particularly when a forced inspiration is drawn; some slight crepitation, audible more especially towards the lower part of each dorsal region; feebleness of the vesicular murmur; and perhaps slight sibilant rhonchus in front. The respiration is, however, quicker and shorter than natural, averaging 28, 32, or 40 in the minute; the dyspnœa is greater than is explained by the obvious physical signs; and most generally there is some lividity of the face.

In the *second* stage all these symptoms are much aggravated. The respiratory acts are performed quickly and imperfectly, the respirations in the minute varying from 30 to 40 or 50. The cheeks are much flushed, and the lips of a somewhat purple colour. Generally there is not acute pain in the chest, but rather a sense of constriction and soreness; the cough, though frequent and occurring in paroxysms, is not usually severe. The expectoration still continues scanty, and consists of small yellowish-white pellets, forming tenacious masses of a peculiar nodulated or botryoidal form, very much resembling, when floating in water, fragments of some of the large oolitic limestones. The tongue is mostly covered with a thick whity-brown fur, and somewhat dry and often red at the tip and edges; or morbidly red and glazed. The pulse is much accelerated, beating 120, 130, or 140 times in the minute, but it is generally small and very compressible. In some instances, after being low and feeble at the outset of the disease, it acquires a more sthenic character in the second stage. The skin is rarely dry, or much above the natural temperature; and the hands and feet are generally cool. The skin of the extremities is also much congested, so that when blanched by pressure, the colour does not readily return. The prostration of strength also becomes greater; and there is much headache, and often transient delirium, especially during the night. On percussion, the chest does not present any marked alteration of resonance, unless there exists some other disease of the lung; and on auscultation crepitation of a more or less fine character is audible with the inspiration, first in the inferior part of one or both dorsal regions, then spreading rapidly higher up in the back and toward the bases of the lungs in front, whilst sibilant rhonchus is heard in other parts of the chest.

The *third* stage of the disease is marked by the dyspnœa becoming so severe that the patients are compelled to sit constantly upright in bed, or to lean forwards, resting on their arms and elbows; whilst at intervals the respiration becomes very laborious. The lividity of the cheeks, lips, and hands is increased; the eyes become prominent; and the expression of countenance is extremely anxious. The cough is frequent, and of a short abortive character, giving the impression of viscid secretion in the lung, which the patient has not power to expectorate; whilst it is aggravated by paroxysms, which cause pain in the head and increased lividity. The sputum now becomes large in quantity; it is of a greenish-yellow colour, very viscid, contains little air, and is occasionally streaked with blood. The respirations are very frequent, 50 to 60, or even more; and expiration is very laboured and prolonged. The pulse is very feeble, and either extremely quick—140, 150, or 160 in the minute—or intermittent, so as to number only 100 or 120 beats. The tongue is covered with a thick yellowish-white or brown fur, and is generally dry; sordes also form upon the teeth. The general surface of the body becomes cool and bathed in perspiration; and the hands and feet decidedly cold. The delirium is more constant; with the decaying strength the cough declines; the expectoration ceases or becomes slight; and the patient sinks.

With the progress of the disease the physical signs change. The chest in front yields a uniformly clear sound on percussion, while behind there is a general impairment of the resonance. The crepitation gradually extends over larger portions of the lungs, being of a finer character in the parts more recently involved; giving place to subcrepitant and mucous rhonchi in the situation in which it was first heard; and finally becoming of a gurgling character in the neighbourhood of the larger bronchial tubes. The subcrepitant rhonchus also towards the end of the attack is heard with the expiration as well as with the inspiration; and, if there is some local condensation, bronchial respiration may be developed.

In the cases which terminate favourably, the amendment is marked by the respiration becoming less hurried and laborious; by the expression of countenance being less anxious, and the face less livid; and by the prostration of strength decreasing. The pulse becomes less frequent, the cough less severe, and the sputum less viscid—more of a muco-purulent character, with a tendency to form a homogeneous mass, containing large air-bells. At a later period it becomes thinner, and declines in amount. The mucous and subcrepitant rhonchi are replaced by finer sounds, and the space over which the morbid signs are heard diminishes—these disappearing first in the upper part of the chest, then at the front and sides, and lastly in the dorsal regions. The clearness of the sound on percussion on the front of the chest also passes away, and is often succeeded by a somewhat dull sound; and the respiratory sounds become indistinct. The convalescence is, however, generally protracted; the patient is liable to returns of dyspnœa at intervals; and the cough continues troublesome. After the subsidence of the pulmonary symptoms, the rheumatic pains, if previously present, may become aggravated, or may then first appear and become troublesome, affecting the head, face, or intercostal muscles, and being aggravated towards night.

Anatomical Characters.—On examination after death, one of the peculiar features of this form of influenza is the extremely inflated condition of the lungs, which, in lieu of collapsing when the chest is laid open, in some cases protrude from the cavity. This condition is not limited to certain parts in which there are larger or smaller bullæ, but consists in a general inflation of large portions of the lung. The mucous membrane of the bronchi is reddened, and the injection increases towards the smaller tubes, where the membrane may be intensely red and have a villous appearance. The lung-tissue in the cases proving fatal at an early period has a peculiar dry appearance, but in the later stages it is œdematous. There is also more or less lobular condensation, the condensed parts being depressed below the adjacent inflated tissue, and having a deep purple colour. At a later period the condensed tissue may soften from the presence of pus, and small cavities may be formed in this manner. The bronchial glands are enlarged and softened. The cavities of the heart, especially on the right side, are distended with firm and more or less decolorised coagula.

Prognosis and Duration.—The cases of influenza complicated by acute capillary bronchitis are always very serious in their character; and when the disease occurs in persons who have before been out of health, and especially if there be any previous disease of the lungs or heart, or if the subjects be very young or elderly, they prove fatal in a large proportion of cases. The duration of the disease in the cases which prove fatal is from about ten to fourteen days; and when recovery occurs, the patient is ill from a fortnight to three weeks, or longer.

Pneumonia.—Of the symptoms in these cases, cough is one of the most troublesome; the expectoration is peculiar, partaking both of the glassy, transparent or opaque character of the sputum of bronchitis, and of the brownish viscid expectoration of pneumonia, with the usual small air-bells. In some cases, however, when there is great prostration, there may be no expectoration. Pain in the chest is generally experienced at the invasion of the disease, of a more or less severe character, but afterwards it is not present to any marked extent, or is only experienced when the patient has a severe paroxysm of coughing. The dyspnœa also is not severe, and there is not much lividity of the face, unless in cases in which there is also considerable bronchitis. The breathing is not usually very rapid, the respirations not exceeding 28 or 32 in the minute. The pulse also is comparatively quiet, beating 80, 90, or 100, and it is usually soft and compressible, or decidedly small and weak. The skin, as in the other forms of influenza, is not generally hot or dry; or, if so at the commencement of the attack, it soon becomes cool and moist. The tongue has usually the whity-brown covering which has before been described, and is not dry; but sometimes it does become dry and brown. There is often very marked disorder of the digestive organs—sickness and vomiting and diarrhœa; and usually some slight jaundiced tinge of the skin is observed. There is also not infrequently some delirium and stupor of mind; and the prostration of strength is often extreme.

On examining the chest, in addition to the signs of bronchitis, which are always present to a greater or less degree, there are the usual indications of pneumonia. At first fine crepitation is perceived in the seat of the disease; to this more or less marked dulness on percussion, bronchial respiration, and increased resonance of the voice and cough, succeed; and these signs, though generally found in one or both dorsal regions, may be more widely diffused. Notwithstanding, however, the threatening character of the symptoms, it was observed in the epidemic of 1847 that the disease was not very fatal, and the signs of consolidation disappeared more readily than in most ordinary cases of pneumonia. The resolution was shown by the return of crepitation, though of a coarser character, in the seat of consolidation; and by the gradual diminution of the bronchial respiration, and of the dulness on percussion. After a time the natural vesicular breathing again became audible. The duration of the disease was very similar to that in the cases of acute capillary bronchitis. In this, as in the other forms of influenza, the convalescence was often very protracted; there was the same tendency to recurrence of the symptoms on any slight exciting cause; and the rheumatic pains often continued long to distress the patient.

3. **Catarrhal Fever,** complicated with **gastro-intestinal affections** and **rheumatism,** and of a **remittent** character.

It has already been stated that more or less marked symptoms of gastro-intestinal and hepatic disorder may be present; and that rheumatic pains, having a more or less decidedly remittent character, may be observed. It has further been said that in the cases in which the pulmonary complication assumes the pneumonic form, these symptoms may be generally more marked than in the cases of acute capillary bronchitis.

In some cases, however, the latter symptoms were, throughout, the predominant feature; and as similar observations have been made as to former epidemics, cases of this kind may fairly be regarded as constituting a special form of the disease.

In this form of the epidemic, nausea and sickness generally occurred at an early period of the attack, and often became very urgent symptoms. The matters vomited often had a bilious tinge; and there was generally a marked bilious tinge of the conjunctivæ and general surface of the body, amounting in some cases to decided jaundice. There was often diarrhœa; and sometimes blood was passed in the stools. The pains in the head, back, loins, and extremities, which are present with more or less severity in all forms of influenza, were from the first of a severe character, or increased with the progress of the disease till they constituted a predominant feature. The pain was usually most distressing in the head, especially in the forehead, and in some cases was limited to one temple, one eyebrow, or one eyeball. This was generally of an intermittent or remittent character, coming on at night after more or less distinct remission during the day; and was attended with singing in the ears, distressing restlessness, agitation, and inability to sleep, whilst delirium generally increased during the exacerbation. In some cases it only amounted to a little excitement and incoherence, but in others it was so urgent as to require the employment of restraint to retain the patient in bed, and sometimes it continued without intermission for some hours. It was, however, remarkable how completely it subsided, as a rule, in the morning. With these symptoms there was usually much tremor of the extremities; and the eye was pale and glassy, though the pupil was frequently contracted.

Early in the attack the pulse was quick and feeble, and of a peculiarly vibratory character, though sometimes it was but little accelerated. At a later period it often became very rapid and feeble, or fell below the natural standard of frequency, being very soft and compressible, and occasionally intermittent. The tongue was at first moist, covered with the usual whity-brown fur, and red at the tip; subsequently it had a tendency to become dry. The breath had a peculiar, offensive, acid odour. Epistaxis occasionally occurred, and sometimes to an alarming amount. The skin was generally moist, and the perspiration had the usual sour rheumatic smell. The urine was at first scanty, but afterwards increased in quantity, and deposited much sediment of urates. Occasionally it was slightly albuminous.

With these symptoms there were evidences of some pulmonary disorder—bronchitis or pneumonia; and very frequently murmurs were heard at the heart, which were not, however, generally persistent.

After the exacerbations the sweating was often very profuse, so that in the morning the patient was found completely bathed in perspiration, and the bedclothes were quite wet. The prostration of strength also was often extreme, so that the hands and feet became livid and cold, and the patient resembled a person in the algide stage of cholera.

Notwithstanding their severity, the cases of this third form of influenza generally did well, though the patients long suffered from the rheumatic symptoms, and only very slowly recovered their strength. As seen from the Registrar-General's reports, there was a great increase in the deaths from 'rheumatism' during the prevalence of the epidemic, which probably referred to cases of this kind.

4. **Modifying Influence of the presence of Influenza on other Diseases.**—In all visitations of influenza of which we have detailed accounts, the epidemic has been attended by an unusual prevalence of other forms of disease, and especially of the specific fevers—and the features of such diseases have been much modified by the epidemic influenza. To this rule the influenza of 1847 affords no exception. As shown by the reports of the deaths in London and the country generally, there was a great increase in the total mortality; this especially showed

itself in the zymotic class of diseases, but obtained also as to diseases of the heart, brain, and digestive organs. An unusual number of deaths were recorded from 'typhus,' under which head were then included the fevers which we now discriminate into typhus, typhoid, and relapsing fever. Of all these forms of disease, cases occurred during the time, though the chief prevalence was apparently of typhoid and relapsing fever. The features of these diseases were generally so much modified by the epidemic influence, and they were so constantly attended by pulmonary complications, that it was often difficult to decide whether any given case was to be regarded as a case of specific fever or of influenza. Various forms of local disease were also prevalent at the time, both as distinct affections, and as complications of specific fever, such as diphtheria, parotitis, otitis, stomatitis, and quinsy, with erysipelas, abscesses, &c.; and these were often attended by great prostration of strength, and added greatly to the danger of the various other forms of disease with which they were combined.

Pathology.—Every phenomenon of influenza points conclusively to the influence of some powerful depressing agent, operating on the nervous system, or entering the blood. The sudden seizure of a large proportion of cases; the extreme prostration of strength from the commencement, and to a degree disproportioned to the amount of local disturbance; the symptoms of disorder of all organs, and especially of the cerebro-spinal system; and the debility which so often succeeds even simple cases of the disease, can on no other supposition be explained. It seems probable also that the affection of the respiratory mucous membrane may be due to the morbific influence, whatever it may be, operating more specifically upon it; but it is extremely difficult to offer even a probable suggestion as to the nature of that influence. The almost simultaneous outbreak of the epidemic in places widely apart; the seizure of a large proportion of the population of a town or district within the course of a few hours; and the sudden illness of individuals or bodies of men visiting a locality where influenza is, or has very recently been, prevailing, and previous to direct intercourse with any persons actually suffering—are all circumstances opposed to the notion of the disease being dependent on infection in the ordinarily understood sense; and might seem to point to the operation of atmospheric influence as the cause. The conditions, however, under which the disease has presented itself in different epidemics render such an explanation impossible. It has travelled over districts without reference to season or climate, and has prevailed in the same locality in all seasons and in almost every variety of weather. It is true that it has often broken out after great meteorological changes, as in the last two epidemics after sudden and remarkable falls from a comparatively high to a very low temperature; but, on the other hand, epidemics have arisen under other circumstances, and such alternations of temperature are frequently observed without the occurrence of an epidemic of influenza. The disease has also broken out at the same time at different places in which the same atmospheric conditions did not exist, so that the operation of the sudden change can scarcely be regarded as acting even as an exciting cause. There can, however, be no doubt that the more common predisponents to disease, such as defective drainage, overcrowding, impure air, deficient clothing, and insufficient or unsuitable food, powerfully conduce to the prevalence and fatality of an epidemic of influenza.

Treatment.—Of the treatment of the simpler forms of influenza it is not necessary to say much. The patient should be confined to bed; have a foot-bath; take some form of diaphoretic medicine; and be allowed a mild, unstimulating diet. If the cough becomes troublesome, or if there be pains in the chest, sinapisms may be applied, and some anodyne may be added to the medicine; and for the relief of the subsequent debility, stimulants, tonics, and a nutritious diet may be enjoined. In the cases complicated with pulmonary affections, the same measures may be used, in combination with expectorants and anodynes; and more decided counter-irritation may be applied to the chest. When there is very copious secretion, and the patient cannot expectorate freely, the greatest benefit is often derived from the use of emetics, and they may be employed with advantage in cases in which the patient's strength is too much depressed to allow of nauseating doses of medicine being given. To the use of emetics, the stimulating expectorants—squill, ammonia, &c.—should succeed. For the relief of the cases in which there is nausea and sickness or vomiting, effervescents with morphine, or hydrocyanic acid, may be given. When there is more or less jaundice, small doses of calomel or grey powder, in combination with Dover's powder, are very beneficial; and when there is diarrhœa, the Dover's powder or decided astringents—such as acetate of lead, or tannic acid—may be employed. When the rheumatic symptoms are severe, the greatest relief is obtained by the administration of small doses of colchicum with bicarbonate of potash and opiates; and when the prostration of strength is great, ammonia, in combination with bark, should be given. In the cases in which there is a decided tendency to remissions and exacerbations, bark also may be prescribed, or, in the more severe cases, quinine; and quinine and other tonics should be freely given during convalescence.

All depressing treatment should be avoided. The patients are too much prostrated to admit of its employment. In each of the different forms of influenza it is necessary to administer support very freely, and sooner or later to exhibit stimulants. In the cases in which there is pulmonary or other local complication, the strength becomes more rapidly and more seriously depressed, and stimulants and support are still more urgently needed; and, indeed, it is necessary to have recourse to them at an earlier period, to exhibit them more freely, and to persevere in their use for a longer period in such affections, when occurring during an attack of influenza, than when arising as idiopathic diseases. In the management also of the other forms of febrile affections which are seen during an epidemic of influenza, a more restorative and stimulating treatment is required than under ordinary circumstances, for all such diseases partake of the peculiarly asthenic type of the epidemic.

Thomas B. Peacock.

The Epidemics of 1889–90–91–92.

Occurrence.—No well-marked widespread epidemic of influenza occurred after that of 1847–8 until 1889. The epidemic which commenced in Europe in the autumn of that year closely resembled previous visitations. It was present at Bokhara, in Central Asia, in May 1889; it was first recognised in St. Petersburg about mid-October; in Berlin and Paris towards the end of November; in Spain and Italy early in December; and in the United Kingdom in the last days of December—although in the light of subsequent knowledge it can be shown that cases occurred in London six weeks or two months earlier. On the western shores of the Atlantic it appeared first in Jamaica early in December; in the eastern ports of the United States about ten days later; and in those of Canada after a further interval of the same duration. The general direction of progress would therefore appear to have been from east to west; but to this there were many exceptions. In Africa the epidemic appeared at Alexandria at Christmas 1889; at Cairo a fortnight later; in Cape Colony in January; in Basutoland two months later; in the Shiré Highlands in October; and in Mauritius in August 1890. India, Ceylon, and Japan were invaded in February, New Zealand and Australia in March, 1890. No transference from east to west, moreover, could be observed in each country invaded; the epidemic, on the contrary, appeared to radiate from the seaports or large towns. In this country, for example, London appears to have been the first English centre of the disease in 1889; Hull in 1891. It is probable that Great Britain had not been entirely free from influenza in the interval between the subsidence of the epidemic in the spring of 1890 and its recrudescence in 1891, but the first town that suffered from distinct epidemic prevalence was Hull; the epidemic began there in the second week of March. Sheffield was attacked about three weeks, Leeds and Bradford about five weeks, later. These towns, with the exception of Hull, had undoubtedly suffered from the epidemic in the previous year. The epidemic also reappeared in London, and affected many of the towns and villages in Yorkshire and the midland counties, but was less widespread than in 1890. The epidemic recurred in the autumn of 1891; in Great Britain it prevailed first in the east of Scotland and the south-west of England. It spread from these two districts over the whole country, and appeared early in the north of Ireland. During the winter of 1891–92 also influenza prevailed as an epidemic in every civilised country, and in every quarter of the globe.

Forms.—The three clinical forms described by the late Dr. Peacock were observed during the latest epidemics. The following classification, which has been very widely accepted, will serve to indicate the general characters of the forms recently most prevalent.

A. *Catarrhal*, marked by conjunctivitis, and a tendency to complications affecting the respiratory tract—pharyngitis, tracheitis, bronchitis, broncho-pneumonia, and pneumonia.

B. *Gastric*, marked by sudden onset of vomiting and diarrhœa.

C. *Nervous*, marked by severe headache and backache, and great depression.

The last-named form was that most often met with. The patient after a slight chill is seized with pain in the eyeballs, frontal headache, and pains in the back and limbs; the backache is in many cases very severe, and has been compared by women who have borne children to the pangs of childbirth. The temperature rises rapidly, reaching its maximum, in a large proportion of cases, within twenty-four hours; the rise is generally limited to 2° or 3°, but temperatures of 104° F., and even higher, have been noted. The duration of the febrile period varies from one to nine or ten days, but is usually three, four, or five days. The maximum is, as a rule, only maintained for a few hours. The fall is sometimes rapid: a distinct crisis, accompanied by profuse sweating, occurs, and the temperature declines to the normal, or even lower, in twelve hours. In other cases the fever has a remittent character, with regular daily fluctuations by which the temperature returns to the normal in two or three days. Relapses were more frequently observed in the recent epidemics than in any previous one: after from four to six days of freedom from fever the temperature again rose, and all the symptoms recurred; as many as three such relapses have been observed.

In a few cases in which the symptoms were otherwise well marked, the temperature remained at or below normal throughout.

The pulse-rate rises with the temperature, but the pulse, even when very rapid, remains soft; slight cyanosis is not uncommon during the pyrexia, and death is sometimes due to cardiac failure; a remarkably slow pulse (50 or less) is occasionally observed during defervescence. During the acute stage the patient experiences great depression and lassitude—symptoms which persist after the pain and pyrexia have disappeared, and are often aggravated by insomnia; in some cases convalescence is prolonged for weeks, or even months, and occasionally well-defined melancholia develops. The prostration is accompanied by anæmia. Acute meningitis, peripheral neuritis, and myelitis may be mentioned among the rarer complications, while neuralgia of various regions is frequently observed, and sometimes persists for long periods. Loss of the sense of taste is a not uncommon symptom, and frequently continues beyond the period of convalescence. Occasionally, either at the onset or during defervescence, the patient passes into a condition of stupor which may be mistaken for catalepsy. The pains in the limbs are sometimes accompanied by a distinct arthritis. Epileptic symptoms of a mild form (*petit mal*) are not infrequent.

The symptoms observed in the gastric form are such as those described by Dr. Peacock under his third form. Children in particular suffer from this form: a sudden attack of vomiting is followed by diarrhœa, the stools being not infrequently bloodstained. The degree of prostration is often out of proportion to the severity of the pyrexia or diarrhœa. The icteric tint of skin, the epistaxis, and the albuminuria noted by Dr. Peacock have again been observed, and a fuller description of the symptoms would merely involve a repetition of what he has written.

The same remark applies to cases with complications of the respiratory tract. Catarrh of the conjunctivæ, nose, and pharynx is present in a very large proportion of these cases, and bronchitis and broncho-pneumonia frequently appear to be merely extensions of the catarrhal process traceable to imprudent exposure. But in some cases pneumonia seems to be the earliest manifestation of the disease. This pneumonia, though lobar in distribution, is probably always catarrhal in type; it is associated with the presence of the streptococcus pyogenes, and ought perhaps to be regarded as a complication occurring very early in the disease; it is frequently accompanied by pleurisy, and occasionally results in pulmonary abscess or in pyo-pneumothorax. The temperature curve is modified essentially by these complications, which tend to prolong the period of pyrexia; when broncho-pneumonia is present, the fall which precedes convalescence is slow and irregular.

Among the very numerous occasional symptoms or complications to which attention was directed during this epidemic, reference may be made to the following. A rash, in some cases erythematous, in others a scattered papular eruption, is occasionally observed. Herpes, sometimes very widespread, and an affection of the cornea apparently of an herpetic character, have also been recorded. Purpura, sub-conjunctival hæmorrhage, and hæmorrhages from the stomach, lungs, or uterus appear to have occurred in an unusual proportion of cases in some localities. The statements of different observers as to the condition of the spleen are conflicting, but it was probably enlarged in half, or in more than half, the cases. Inflammation of the middle ear has been frequently noted.

Morbidity and Mortality.—One attack of influenza does not afford more than a very imperfect protection against a second. The proportion of the population affected by the epidemic has been very variously estimated: in St. Petersburg it was put at two-thirds, in Berlin at one-third, in London at 13½ per cent. Among the soldiers of the Home District during the first eighteen days of the epidemic (after which it very rapidly declined) the percentage admitted for treatment was 10·57, while one-third of the persons employed in the General Post Office suffered. Mr. Smee has estimated that 8 per cent. of the total population of Europe were attacked during 1889–90. The mortality ascribed to influenza directly was not large, but on this as on previous occasions the occurrence of an epidemic of influenza has had a very remarkable effect upon the death-rate of a town. In London, for instance, the death-rate rose from 20·3 in the week ending December 28, 1889, to 32·4 in the week ending January 11, 1890; in 1891 the death-rate in Sheffield rose from 21·7 in the week ending April 4 to 70·5 in the week ending May 2; in Paris at the height of the epidemic the number of deaths from all causes was nearly trebled. An analysis of the vital statistics of the towns and countries affected shows that the excessive mortality produced by influenza is due mainly to a large increase in the number of deaths attributed to diseases of the respiratory organs, and secondarily to an increase in those attributed to diseases of the circulatory system. In London the number of deaths registered in the four weeks of 1890 during which the epidemic was at its height was 2,258 above the average; the deaths due to diseases of the respiratory organs were 1,791 above the average; while those due to diseases of the circulatory system were 318 above the average. This excess of deaths due to respiratory diseases was made up as follows: Bronchitis, 911; pneumonia, 465; phthisis, 337;

other diseases of the respiratory organs, 78. Bronchitis and pneumonia have already been enumerated among the commonest complications of influenza; the increased number of deaths from phthisis was due partly to the prostration which accompanied influenza, but mainly to the broncho-pneumonia which it produced.[1]

Morbid Anatomy and Pathology.—The morbid changes found after death from influenza are of a very varied character, and are in the main to be attributed to the complications by which death has been brought about. Those due to influenza itself are of a character common to all forms of acute infective disease—namely, parenchymatous degeneration of the liver, kidneys, and spleen, of the muscular substance of the heart, and of the minute vessels. The last named may lead to capillary hæmorrhages into the viscera or nervous centres. The spleen has been found much enlarged and almost diffluent. Numerous bacteriological examinations have shown that in pneumonia complicating influenza the diplococcus pneumoniæ is present in some cases, the streptococcus pyogenes in others. In the bronchial sputum these two microbes have also been found, while in the secretion of the nasal cavities the staphylococcus aureus and albus and the capsule-bacillus of Friedländer, as well as two species of bacilli capable of producing pneumonia in rodents, have been detected. The micro-organisms thus far enumerated must be regarded as the causes, not of influenza, but of its respiratory complications. Klebs has stated that the blood during the febrile stage contains flagellate protozoa in very large numbers, either free in the plasma, or adhering to or within the red blood-corpuscles; he compares them to the monads of malaria. His observations have not been confirmed.

More recently (January 1892) a bacillus, previously unknown to bacteriologists, has been asserted to be the specific exciting cause of influenza. Pfeiffer, who found it in all the patients (thirty-one) he examined, states that in uncomplicated cases it exists alone, and in enormous numbers, in the bronchial secretions, and is capable of penetrating into the peribronchial tissue, and even to the surface of the pleura. Canon found it in the blood during the febrile stage, and in larger number during defervescence. The bacillus, which is very minute, being smaller than that of mouse-septicæmia, grows at temperatures above 28° C. on glycerine-agar, forming small colonies looking like drops of water. These colonies do not run together, but remain distinct. The bacillus, which is immobile, also grows in *bouillon*, forming in time a white woolly mass at the bottom of the vessel.

Ætiology.—The history of the epidemic now under consideration strongly supports the view that influenza is propagated mainly, if not entirely, by human intercourse. The evidence in favour of this has been fully stated by Dr. Parsons.[1] The epidemic has not travelled faster than human beings could travel, but it has travelled faster during this epidemic than at earlier dates, when means of communication were less rapid. It has in each country appeared first in towns; and the towns earliest affected have been the capital, or seaports, or frontier towns having trade with countries already affected. There has been no steady progress from east to west, either over the world or in particular countries; and neighbouring communities have often suffered at considerable intervals of time. The recent epidemic has not afforded indisputable instances of sudden outbreaks without antecedent cases; but, on the other hand, a large amount of evidence has accumulated proving that the disease has been introduced into each district by individuals coming from places where the epidemic already prevailed, and that the first cases in the new localities have occurred in persons brought into intimate relations with the new arrivals. The interval between the first case of the disease in a community, and the next developing in relation with it, has been found to vary from two days, or less, to seven or eight days. A considerable number of instances has been recorded in which an attack of the disease has followed a short interview with a patient already suffering; the usual interval in these cases has been two to three days. If the earlier cases were overlooked owing to their being few in number and of a benign character, it would appear as if the disease had suddenly broken out, and not that it had merely increased in severity and in the number of its victims.[2] The influence of human intercourse is also seen in the following facts: (1) Persons living in suburbs going daily to business in the town have generally been the first to suffer, other members of the households, and persons employed in the suburbs, being attacked later; (2) persons employed together in large numbers in enclosed spaces have suffered in larger proportion than those employed few together or in the open air;[1] (3) in institutions in which the inmates were brought much into association, the spread of the epidemic has been more rapid and extensive than in those in which the inmates were more secluded from one another.

---

[1] The Registrar-General states that, in 1890, the number of deaths in England and Wales directly attributed to influenza was 4,523, but he estimates the number directly and indirectly due to it at 27,000, which is equivalent to a death-rate of almost 1 per mille.

[1] These paragraphs have been re-written since the publication of Dr. Parsons's exhaustive report (*Local Government Board Report on the Influenza Epidemic of* 1889–90, by Dr. Parsons); but the writer had previously become convinced of the correctness of the view therein set forth.

[2] If it be assumed for any disease that it has an incubation period of two days, and that each patient communicates the infective principle to two others, then the number of persons attacked on the twenty-first day would be over one thousand, and on the twenty-seventh day over eight thousand.

The fact remains, however, that it is not always possible to trace communication between an infected area and that in which a fresh outbreak occurs; and the acceptance of the view that influenza is, as a rule, transmitted by human intercourse, does not necessarily involve the assumption that the virus cannot be propagated outside the human body.

The opinion that influenza may be conveyed by direct infection from the domestic animals, more especially the horse, found support in the prevalence of the disease called influenza among horses in England for some time before the epidemic outburst, and in its reappearance in 1892. Similar observations have been made during previous epidemics, but on other occasions influenza has prevailed as an epizootic without any coincident epidemic; persons employed in attending on horses suffering from influenza have not suffered earlier or more than other members of the community, and influenza has occurred among stablemen without any coincident epizootic. Under the name 'influenza,' however, several diseases of the horse are probably confounded; and though recent evidence is opposed to the view that the equine disease can be communicated to man, the possibility of such an origin cannot be absolutely denied.

The sudden onset of the disease, the short duration of the febrile paroxysm, and the occasional occurrence of relapses, have been quoted in support of the theory that influenza is allied to malarial intermittent. The mode of spread of the epidemic along commercial routes, its rapid dissemination, and the absence of any constant antecedent meteorological conditions, militate against the view that it is a miasmatic air-borne disease.

The resemblance of the disease to dengue (*see* DENGUE) has been pointed out by many writers, some of whom have held that the recent epidemic was dengue. In various parts of the Levant an epidemic of dengue preceded by a few months the recent epidemic of influenza, which there presented the same clinical features as in Northern Europe. Dengue, however, is a disease of warm climates and of hot seasons; it spreads much less rapidly, and an epidemic persists in a locality much longer; further, though individual cases of the two diseases may resemble each other very closely, the general clinical picture is different. In dengue the fever is generally higher, an exanthem is the rule, the pains in the limbs are more distinctly localised in the joints, and the complications so commonly observed with influenza are rare in dengue.

As to the mode of origin of epidemic influenza, and the circumstances which favour its wide dissemination, nothing has been certainly ascertained. It has been imagined that under certain favourable conditions it may be evolved from 'a common cold,' and in support of this hypothesis it has been pointed out that the early cases in each country during the recent epidemic were of a mild type, and that the latest were often the most severe. The nature of these favourable conditions, however, has not been defined, and it can only be said that they have nothing to do with temperature, moisture, or wind, and are, in fact, entirely unknown.

It has been asserted that influenza is endemic in various parts of the Russian empire and in China, and it is the fact that the direction in which the epidemic spread on this, as on former occasions, is not incompatible with the view that it had its origin in Eastern Asia.

TREATMENT.—But little can be added to the observations made under this head by Dr. Peacock. No specific has been found, and the treatment adopted has been mainly symptomatic. Phenazone and phenacetin were used with some success to subdue the severe headache and muscular pains; salicylate of sodium or salicin seemed to be of value, especially in cases presenting rheumatic symptoms; restlessness and insomnia have been treated by preference with bromide of ammonium. The danger of using depressant remedies is universally recognised. Quinine has been extensively used, both as a prophylactic and in the early stage of the attack; its value, whether as a prophylactic or as a remedy, is probably very small. The preparation most generally used was the ammoniated tincture, and the moral effect of moderate doses of this not unpalatable drug has probably been distinctly favourable during the first days of alarm and panic.

The main point in successful treatment is a recognition of the truth that influenza is a serious malady, and not to be compared to a 'common cold.' A patient who fights against the disease in its early stage, or who returns to work too soon after the subsidence of acute symptoms, is far more likely to suffer from the severe pulmonary complications, more especially pneumonia, than one who submits to treatment early, and continues to take precautions against cold and over-exertion until his strength is completely regained. There is, probably, no one circumstance which would tend so much to diminish the mortality from influenza as attention to the rule which has been formulated by some—

---

[1] For instance, among men employed by the London and North-Western Railway the proportions were very different: 4·7 per cent. of the drivers and firemen, and 11·5 per cent. of the clerks, were attacked; of 122 seamen employed by the same company 6 were attacked; of 709 hotel servants 100 were attacked.

forty-eight hours in bed after the temperature has become normal.[1]

If the view be accepted that epidemic influenza is, in nine hundred and ninety-nine cases out of a thousand, communicated by infection from the sick to the healthy, then the propriety of protecting delicate and aged persons, and patients suffering from phthisis or other pulmonary disorders, is obvious. The view in question is so highly probable that it would appear to be proper to act upon it.

Dawson Williams.

INHALATION, Ætiology of.—*See* Disease, Causes of.

INHALATIONS, Therapeutic Uses of (*inhalo*, I breathe in).—Inhalation is a method of applying remedial agents to the respiratory tract, whereby these substances in a gaseous or atomised form are brought into contact with the mucous membrane of the nose, mouth, pharynx, larynx, and bronchi, and may even penetrate to the epithelium of the air-cells. Inhalation dates from the days of Hippocrates and of Galen, and has been more or less in vogue in all ages; but only lately has it been proved that the inhaled material passed through the finest ramifications of the bronchi into the pulmonary alveoli, and in some instances became absorbed by the capillaries, thus entering the general circulation. The examination of the lungs of colliers, grinders, and others engaged in dusty occupations has shown that the inhaled dust can be detected in the lung-tissue, where it induces chronic pneumonia. The experiments at the Académie de Médecine proved that medical sprays are equally penetrating.

Methods.—The modes of inhalation vary with the drug used, depending mainly on the temperature at which it volatilises, and also on the medicinal effects aimed at.

Chloroform, ether, bichloride of methylene, and nitrite of amyl evaporate at ordinary temperatures, and only need to be diluted with air to be safely inhaled. Calomel and sulphur are sublimed at high temperatures in special apparatus; but the majority of drugs are best vaporised through the medium of hot water or steam, or reduced to fine spray by passing compressed air through their solutions.

Many forms of inhaler are in use, but in selecting one for warm inhalations the requisites are—(1) that it can be used without difficulty by the patient; (2) that a temperature of 130° to 150° F. can be steadily maintained; (3) that the steam be thoroughly impregnated with the medicament; and (4) that the inhaling tube be fitted to the nostrils as well as to the mouth, so as to ensure a sufficient supply of the inhaled vapour. Lee's steam-draught inhaler is especially useful for projecting a full current of steam into the throat and air-passages. The force and temperature are alike controlled by the sliding valve on the inhaling pipe. When no inhaler is at hand, a jug with a wide mouth, and half filled with hot water, may be used, a towel being placed round between the mouth and nose of the patient and the opening of the jug, to prevent the escape of the vapour into the air.

Varieties and Uses.—Inhalations are employed chiefly in diseases of the pharynx, larynx, and air-passages, and may be classed as *sedative*, *stimulant*, and *antiseptic*.

Sedative.—Steam is soothing to the throat, when this part is dry, inflamed, or irritable. In incipient laryngitis and croup, as well as in irritable bronchitis, the inspiration of steam from specially arranged kettles is very grateful, the moist vapour promoting secretion and expectoration.

Jets of steam are used in hospitals and bath establishments as vehicles for the inhaled drugs, and are directed into the patient's mouth.

As sedatives the vapor coninæ and the vapor acidi hydrocyanici of the pharmacopœia are recommended in cases of laryngeal or pulmonary irritation. A sedative inhalation made of one part of chloroform and two or three of rectified spirit—of which one teaspoonful may be added to a pint of water, at 60° to 100° F.—is much commended in hay fever and laryngeal spasm. A combination of chloroform and conium, in the proportion of 5 minims of the former to 1 drachm of the succus conii, in half a pint of boiling water, is useful in phthisis and some forms of asthma. One drachm of liquor potassæ should be added, for this promotes the volatility of the conine, as in the official vapor coninæ. It must be remembered that chloroform is very powerful when given with steam as an inhalation. One drop of chloroform in a pint of water at 150° may produce giddiness.

Stimulant.—Stimulating moist inhalations can be prepared with various volatile oils. Oils of pine and of cubebs are useful stimulants in cases where there is much secretion from the throat and air-tubes. Thus 2 drachms of oil of pine or oil of cubebs may be mixed with 60 grains of light carbonate of magnesium in 3 ounces of water; and of this mixture 1 drachm may be used in a pint of water at each inhalation. One drachm of the compound tincture of benzoin, in half a pint of hot water, is often useful in chronic bronchitis and laryngitis. Oil of turpentine or the vapor olei pini sylvestris of the pharmacopœia makes an excellent stimulant inhalation in cases of dilated bronchi.

---

[1] It has been asserted that recent vaccination affords some protection against influenza. The experience of Sheffield, where a severe epidemic followed shortly after an epidemic of small-pox had led to a very general resort to revaccination, appears to be sufficient to disprove this theory, which, in fact, seems to rest upon no solid groundwork of facts.

Antiseptic.—Antiseptic inhalations are used where the object is to correct a fetid secretion, as well as to stimulate the secreting membrane to fresh action. In fetid bronchorrhœa, in gangrene of the lung, in fetid abscess, and in pyo-pneumothorax, benefit is derived from the vapor creasoti, the official vapor iodi, or from glycerine of carbolic acid (from 2 to 3 drachms to the pint of boiling water), or again from oil of thymol, prepared like the other essential oil vapours, with light magnesia and hot water (60 grains to the 3 ounces). Carbolic acid vapour can be well diffused in a room by mixing the acid with water in Lee's steam-draught inhaler, or by dropping the acid on a hot plate of metal as in Savory & Moore's carbolic vaporiser. Creasote or eucalyptus oil, mixed with an equal quantity of ethylic alcohol, is often employed in the form of drops (10 to 20 drops at a time) on a small sponge placed in a perforated zinc respirator. The respirator thus charged is worn by the patient for one hour morning and evening, with a view to improving the state of the lungs. After a free morning expectoration the respirator-inhaler should be used, and instruction given to inspire deeply by the mouth and expire through the nostrils with the mouth closed.

Antispasmodic.—The fumes of burning nitre-paper are employed as inhalations in cases of pure spasmodic asthma uncomplicated with bronchitis. The paper—prepared by soaking white blotting-paper in solution of nitrate of potassium (30 to 40 grains in an ounce of water)—is sometimes washed over with tincture of benzoin, and this, in certain cases, may be an improvement; but in ordinary forms of asthma the nitre-paper, burnt till the patient is enveloped in smoke, will usually relieve the asthmatic paroxysm. The fume of a grain of powdered opium volatilised on hot metal has been praised as a remedy to cut short nasal catarrh; as well as smoking solid opium in the Chinese fashion through a pipe, in spasmodic asthma. Cigarettes, pastilles, and powders containing stramonium, belladonna, and other antispasmodics, are well known as remedies in spasmodic asthma.

Atomised inhalations of spray have of late years come into deserved repute as valuable aids to the treatment of chronic diseases of the throat and lungs. The principle of the hand-ball and steam-spray atomisers is that, if two capillary tubes are placed at a certain angle to each other, one dipping into a fluid, while through the other a stream of air is driven by heat or compression, a vacuum is formed in the first, causing the liquid to pass out in the form of fine spray. In using these instruments, the operator should seek to blow the spray into the patient's throat at the time when an inspiration is being taken, as thus the spray will obtain a free entrance through the larynx into the trachea. It is doubtful if much spray enters the air-tubes; some certainly does, as has been stated above, but the cold sprays do not appear to afford so much relief to affections of the lungs as the warm inhalations. In cases of tumidity of the larynx, a spray containing 10 grains of alum to 1 ounce of distilled water may be used. In place of alum, 2 grains of sulphate of iron, 5 grains of sulphate of zinc, or 5 grains of dry chloride of iron, in 1 ounce of water, may be employed. For antiseptic purposes, 5 minims of sulphurous acid, or 1 minim of carbolic acid, to 1 ounce of water, or a like quantity of solution of iodine, may be used. In putrid sore-throat and diphtheria the writer has seen excellent results from iodine, either inhaled in vapour or applied in solution. Three and a-half drachms of lactic acid in 10 ounces of water form a solution which, thrown as spray into the throat, is of use in diphtheria; it seems to dissolve the exudation. As a styptic and hæmostatic spray 50 to 200 grains of tannic acid are employed, dissolved in 10 ounces of water, but for relaxed throat a weaker solution is useful. For sedative purposes a solution of bromide of ammonium, or one containing half a grain of acetate of morphine to 1 ounce of water, may be employed. Diluted ipecacuanha-wine spray is said to be very efficacious in relieving the dyspnœa of chronic bronchitis and emphysema. This spray in a few instances may induce vomiting, but this accident may be obviated by diluting the wine with a considerable proportion of water. All these spray solutions should be filtered through paper, otherwise they may contain small particles which clog the aperture of the atomiser. At the Continental spas it is usual to medicate large chambers by means of sprays and vapours, in which patients can sit for hours breathing the artificial atmospheres; and in this way various mineral waters, such as those of La Bourboule, Aix-les-Bains, and Cauterets are locally applied.

Insufflation is a method of applying powders to the larynx. A vulcanite tube curved at a suitable angle is carried over the tongue to the laryngeal aperture, and then the powder, which has been introduced through a small opening covered by a slide in the tube, is blown into the larynx and trachea. The blowing is effected sometimes by an elastic ball at the end of the tube, at other times by the mouth of the operator. In laryngeal phthisis $\frac{1}{20}$ to $\frac{1}{4}$ of a grain of hydrochlorate of morphine, mixed with sugar of milk, may thus be blown into the larynx, and often with great comfort to the patient. A grain of iodoform and a grain of boric acid are often added to the morphine powder.

John C. Thorowgood.

INJECTION (*injicio*, I throw in).—Synon.: Fr. *Injection*; Ger. *Einspritzung*.

Definition.—Injection is the act of introducing a fluid into any part of the body, by means of a syringe or similar apparatus. The word is also employed to designate the fluid so introduced.

Varieties.—Injections are chiefly used in the treatment of disease; but reference must also be made to the method as it is practised by anatomists for the preservation of 'subjects' for dissection; and for the purpose of filling the blood-vessels, lymphatics, ducts, cavities, spaces, &c., preparatory to microscopical examination.

The therapeutical application of injections comprehends the following measures:—

1. *Hypodermic* or *subcutaneous* injection, in which the fluid is injected under the skin. *See* Hypodermic Injection.

2. Injections into the natural *canals* or *open cavities* of the body; for example, the external ear, the Eustachian tube, the nose, the nasal duct, the stomach, the rectum (*see* Enema), the urethra, the bladder, and the vagina and uterus. The various forms of injections just indicated will be found fully discussed under the diseases of the several organs.

3. Injections into *shut sacs*, normal or morbid; such as the tunica vaginalis, the serous cavities, the synovial cavities, the sheaths of tendons, and cysts and chronic abscesses. The fluids used in this class of injections are generally stimulant, such as a solution of iodine. *See* Hydrocele.

4. *Intravenous* injections, the fluid introduced into the circulation being either blood (transfusion), saline solution, milk, or some other kind of nutritive material. *See* Transfusion.

J. Mitchell Bruce.

INOCULATION (*in*, into; and *oculus*, a bud, a graft).—As usually understood, inoculation is either an operative procedure or an accidental occurrence, by means of which morbid materials are brought into direct contact with the minute vessels of the skin or of a mucous membrane, or with those of the subcutaneous or submucous tissue, so that they are readily and speedily absorbed, the result being that they originate certain definite and specific diseases, varying with the nature of the material thus introduced into the system. In short, inoculation, as commonly practised or observed, is a mode by which the contagia of certain specific diseases are directly conveyed from one animal or individual to another; and some of these affections can only be thus transmitted, while others are capable of being communicated in other ways, but in this way most effectually and with the greatest degree of certainty. The most familiar examples of diseases thus transmitted are vaccinia, small-pox, syphilis, and hydrophobia. It need hardly be mentioned that vaccinia can only be conveyed by inoculation, and it is for the purpose of inducing this disease that the method is ordinarily intentionally practised, so that the terms *vaccination* and *inoculation* have come to be popularly regarded as synonymous (*see* Vaccination). Under certain exceptional circumstances inoculation of the contagious matter of syphilis, small-pox, or anthrax is employed, with the deliberate purpose of originating these affections. The inoculation of the modified virus of rabies, according to Pasteur's method, is generally recognised as a most valuable plan of treatment, with the view of preventing the development of hydrophobia in those into whose system the poison has gained access, either owing to the bite of a rabid dog or in other ways (*see* Hydrophobia). The employment in this way of tuberculin, for the supposed cure of phthisis and other forms of tubercular disease, according to Koch's method, or of tuberculinin, must also be mentioned here, but without comment (*see* Phthisis; and Tubercle). Inoculation has been much practised of late years in experimental pathology, by which the effects upon the system of the introduction of septic liquids have been demonstrated; as well as of certain solid morbid products. *See* Contagion; Immunity; and Infection.

With regard to the modes by which inoculation is effected, it need only be said here that, when it is practised as an operation, the material is usually introduced into the subcutaneous or submucous tissue, by means of a lancet or other pointed instrument, or, in certain cases, with the aid of a hypodermic syringe. Sometimes the surface of the skin is merely scarified, so that the epidermis is more or less destroyed; or this is removed by some blistering agent, and the contagious substance then applied to the exposed cutis. Accidental inoculation may take place in connexion with any abrasion, wound, or ulcer on the skin or on a mucous surface; or by the bites of animals, as in the case of hydrophobia.

Frederick T. Roberts.

INSANITY.—Synon.: Fr. *Folie*; Ger. *Geisteskrankheit*; *Geistesstörung*.

Insanity is popularly known as disorder of mind: as physicians, we know it to be disorder of the highest organs of the nervous system which unite in the performance of that function recognised and spoken of as mind. There can be no disorder of mind without disorder of brain: as physiologists and pathologists we have to study and treat the latter, and for this reason the legislature enacts that certificates of insanity shall be given by medical men, and by them alone, and that to their care shall be committed those who are insane.

As a preparation, then, for the study of insane mind, the learner ought to acquire a knowledge of healthy mind—the healthy function of a healthy brain. He must know what are the structures which combine to make up that which we call the cerebrum, and contribute to its healthy working, and must trace the growth and development of this working from the earliest days of infancy to the time of adult life. He will perceive that the growth of mental function is as gradual as that of bodily power; that in some it may be more rapid than in others, like that of the body; that it may be arrested in its development, or stunted and deformed; and that it may by imperfection of the organs, as blindness or deafness, be impeded or stopped. In all particulars it will be found subject to the laws which regulate the growth of the body generally.

Before examining brain-function, it will be necessary to become acquainted with the various structures which form the cerebrum. The brain of man, and indeed of all vertebrates, is made up of nerve-cells and nerve-fibres; of a substance or *stroma* in which the cells are imbedded, called neuroglia; and of blood-vessels and lymphatics. The nerve-cells are gathered into convolutions or *centres*; and by means of the nerve-fibres communicate with the organs of special sense, with the sensory ganglia and spinal cord, with each other, and with the convolutions of the other hemisphere. Modern science is endeavouring to throw light upon the nature and uses of these convolutions. The seats of the highest intelligence, they at the same time appear to be centres of voluntary motion, and of the outward manifestation of intellectual action. *See* CONVOLUTIONS OF THE BRAIN AND CORTEX CEREBRI, Lesions of.

Concerning the physiology of the blood-supply of the brain there is still great doubt and controversy. Anatomically we know that from the internal carotid and vertebral arteries, combining in the circle of Willis, there pass to the brain-substance the anterior, middle, and posterior cerebral arteries. The terminations of these ramify in the pia mater, and thence send many small vessels to the grey matter, and fewer, but larger, ones to the white, the supply of blood to the former being much the more plentiful. That, however, which chiefly concerns the student of insanity is the vaso-motor system of nerves which controls and regulates the blood-supply. Modern research appears to render it more and more certain that the condition of insanity, at any rate in its early and acute stage, is mainly one of increased blood-supply. On what does this depend? To this question no precise answer can as yet be given. Investigations are still being made as to the nerves which dilate and contract the vessels; but with regard to this subject, and the so-called inhibition of nervous influence, much more must be ascertained before the pathology of insanity can be definitely fixed. The lymphatics of the brain are also, according to some observers, largely concerned with the disturbance of mental function, if it should happen that by being blocked up or impeded they fail to carry off the waste products of the organ. They are contained in perivascular lymph-spaces, lying between the outer fibrous coat of the blood-vessels and a hyaline membrane or sheath of pia mater which separates them from the brain-substance.[1]

Even concerning the neuroglia, controversy exists. Is it merely connective tissue, or is it nerve-structure? Authorities lean to the former view, and the increase of it in diseased brains seems to point to a growth of lower structure at the expense of higher.

Passing to the functions of the brain, the phenomena comprised under this name are of two kinds. There are the various movements excited by the stimulation of the different brain-centres, on which the experiments of Dr. Ferrier have thrown new and interesting light. But these are not the phenomena of mind. The latter can only be studied by observation of a totally different character. For mind implies sensation, feeling, consciousness; and as we have no consciousness of any feelings but our own, it is evident that here objective observation is insufficient, however unwilling physiologists may be to admit it. Yet the subjective examination of ourselves is as inadequate by itself to explain the phenomena of diseased mind, as objective observation is to make known the nature of mind in general. We must use the subjective method as our key, and by means of it open up and interpret the phenomena of mind; we may then objectively examine the mental characteristics, the growth and development, the diseases and decay of mind in all human beings, children or adults, idiots or insane, and by tracing thus the effects of injuries and disease, we arrive at a knowledge of the differences between sound and unsound mind.

By observation of the movements brought about by nerve-function, we perceive that they follow the application of a stimulus, and that many actions take place in response to stimuli which we call reflex, instinctive, or automatic, before those begin which are the product of mind in its highest sense. For mind grows slowly and gradually. The first movements of the child, reflex or instinctive, are the result of stimulation of nerve-centres, but are only slightly, if at all, attended by consciousness. This becomes appreciable later, and with it the commencement of *memory* and *ideas*, as the feelings roused by stimulation are stored away in the mind, to be reproduced as some new stimulus is presented to them. The various brain-centres are in this manner stored with ideas, the result of experiences derived from without, and by means of the nerve-fibres they are united in groups till a most complex system is evolved. The sensations are developed into more and more complex feelings, till the highest emotions of civilised man are reached; and in a similar manner the intellectual processes grow from mere perceptions and cognitions to the highest trains of thought. Mind may be said to be made up of feelings and the relations between feelings, for the intellectual element of mind is the relational element, and it will be found that we cannot locate in two parts of the brain the emotions and the intellect, as some physiologists have proposed ; for no kind of feeling, sensational or emotional, can be wholly free from the intellectual element; and on the other hand it very rarely happens that any act of cognition can be absolutely free from emotion.[1]

---

[1] Dr. Batty Tuke. Morisonian Lectures. *Edinb. Med. Journ.*, Dec. 1874.

For the growth of healthy brain and mind all the conditions of physical health are necessary. If at birth there is inherited defect or accidental injury, or if at any subsequent period development is arrested or perverted, idiocy or imbecility is the result. There will be an imperfect recording of the experiences of life, an inability to learn, and a deficient power of bringing into relation one with another the various groups of nerve-centres which make up the brain, and are the seat of mind.

If, however, growth and development have proceeded normally, and normal mind is the result, what are the conditions of insanity, or disorder of mind? What are the conditions of healthy and unhealthy brain-function?

I. We know by experiment on nerves and nerve-centres, and by observation of the objective phenomena of motion, that a discharge of nerve-force or nervous fluid—call it what we will—is liberated when a centre is stimulated, and that this ramifies according to its quantity in various directions throughout the system. When there is health and vigour the supply will be large, and every channel both in the brain and body will be duly supplied. But in the healthiest nervous system there must in time be a cessation of this discharge, for the supply will be exhausted, and repair and replenishing must take place. And unless this is done, nerve-function will be impaired or cease. For the repair of the higher nerve-centres sleep is necessary, for only during sleep is the repair of the waste effected, and we commonly, nay, constantly, find that mental disturbance is preceded by loss of sleep.

In some cases want of sleep may depend on the actual time allowed for it being insufficient. Though not a very common cause of insanity, yet it sometimes is found in persons who are very hard-worked, or who, by religious exercises and services, deprive themselves of sleep. In the great majority, however, want of sleep is the result of a pathological condition of the brain, or in connexion with disorder of the liver or other remote organ, conditions which by appropriate treatment the physician seeks to remedy as the first step towards the cure of the insanity.

Not only may there be a want of repair and replenishing of the nerve-force expended, but there may be also a defective generation and supply of it. Through anæmia, or exhaustion from acute diseases or long-continued illness, the nerve-centres fail to generate from the blood the power necessary for their due operation. The discharge liberated does not ramify throughout the nervous system, calling into action every part of the brain, and penetrating to every portion of the muscular structures ; thus the failing supply is manifested in the gloom of *melancholia* and the slow and torpid movements which accompany it; and when it is reduced to a still lower ebb, there may be not enough to carry on even the semblance of mind: the patient presents the appearance of utter fatuity seen in *dementia*, whether primary or secondary, and either sits motionless and lost in the condition termed *melancholia cum stupore* [Fr. *mélancolie avec stupeur* ; Ger. *Schwermuth mit Stumpfsinn*], or executes the purposeless and automatic movements of acute dementia [Fr. *Démence aiguë*].

The defect of nerve-force may bring about insanity in more than one way. A sudden strain or shock may make an unwonted demand upon the nervous supply. Incessant thought, especially of a painful kind, may use up the reserve of force; this is not renewed, and insanity is the result, the increased molecular discharge not being duly compensated by an increased supply from the nutritive sources. Secondly, the supply may fall so far below the standard, that it is not sufficient for the ordinary demands of everyday life, and so, without any mental cause, but simply from nerve-inanition, the stage of depression appears.

II. It may be, however, that there is not so much a defect of nerve-force, as an unstable condition of the cerebral centres, which is manifested by a rapid and continuous discharge. Such a discharge in a more sudden and violent form we are familiar with in the phenomena of epilepsy. In insanity it may vary from undue hilarity and excitement up to the incessant movements and vociferation of acute delirium; and, like epilepsy, it may terminate in exhaustion, coma, and death. The supply of nerve-force in such cases is often abundant. The patient goes without sleep for days and nights, and yet recovers. The higher brain-centres lose the power of control, owing to the violence of the discharge, and the lower and more automatic centres thus liberated are stimulated to over-action, which is manifested in noisy and violent delusions, and so on to mere delirious incoherence. And, after the discharge has ceased, there may be a period of dementia and complete obliteration of mind, before the exhausted brain begins to recover. Persons who are in this condition of unstable nerve-equilibrium may be thrown off their balance by mental causes—by shock, or grief, or losses. Their brain may also be affected by disorder of the other organs of the body *sympathetically.* In all such patients there is a predisposition, often inherited, to nervous instability and rapid discharge, and such 'causes' as puberty, pregnancy, or child-birth bring about an explosion. Here, too, there is marked cerebral hyperæmia, producing an abnormal nutrition and corresponding abnormal function.

---

[1] Herbert Spencer, *Principles of Psychology*, vol. i. p. 473.

III. Disturbance or defect of mind may be caused by incomplete development of any part concerned in mental action, or by the presence of anything within the cranium which interferes with the healthy life of the various organs. There may be tumours of different kinds, or abscess. Insanity may also follow blows on the head; and deterioration of brain-tissue is frequently caused by the action of alcohol and other poisons. In these cases we have not a functional disturbance which may suddenly arise and as suddenly pass away, but a gradually developed organic lesion, which usually advances, producing serious and permanent results. The degeneration of the organ and its tissues through age will also produce corresponding results.

SYMPTOMS.—What are the symptoms of insanity, and how far do they correspond to the pathology of brain-disturbance as set forth in the above remarks?

The first symptom usually noticed in a person becoming insane is an alteration in his *emotional* condition. Either he is more quiet and dull than usual, or, on the contrary, more restless, irritable, excitable, or hilarious. The dulness may vary from a mere disposition to sit still, and neglect his work or amusements, to actual gloom and despondency. The restlessness and excitement may also vary in degree, and be accompanied by gaiety or outbursts of anger and of violence. The change may be more or less concealed, according as the patient can or cannot control himself. Those of his own family or people about him may notice it long before others, and this stage will vary in duration, often lasting some time before delusions or other marked symptoms are discoverable.

The *acts* of the patient will correspond to his altered feelings. His relations towards the outer world will be changed. In his torpor or gloom he will look on everything despondingly, will be unable to perform his duties, will not care for amusements, will sit at home inactive, or take up morbid fancies about his health. On the contrary, he will act rashly in matters of business, embark in foolish speculations, take no heed of time or appointments, spend money recklessly, indulge in debauchery or frivolous pursuits, show causeless anger to those about him, or exhibit silly and childish hilarity when matters of grave moment are pending.

Here we have a *slight insanity.* The higher brain-centres are but slightly disturbed, and can still exercise a considerable amount of control over the lower and less specialised centres. It may be difficult to say that any one act or feeling is of itself indicative of insanity, but the patient is a changed man, and the term *moral insanity* is specially applicable to this condition.

Such an insanity may remain and be permanent; more frequently, however, it either passes off, the patient recovering, or it advances in one or other of the directions already indicated. The gloom will increase; corresponding delusions will present themselves, with appropriate acts and conduct; and the patient will drift into *melancholia.* Or he will become more and more hilarious, angry, excited, or suspicious, and a state will arise to which for want of a better we give the name of *mania.* Though delusions are not usually found in the stage of alteration, they are seldom absent in the second and more advanced period, and generally correspond to the feeling of the sufferer, so much so that his appearance and humour, so to speak, frequently enable us, without previous information, to arrive at the delusions under which he is labouring. This stage is often called *intellectual insanity*, or insanity with delusions. Patients labouring under one or other of these forms vary in the degree of insanity, from a condition in which they are able to talk coherently on many topics to one of complete incoherence or delirium. To the former the name of *partial insanity* is often applied.

Another condition is that of fatuity or childishness in various degrees. It may come on rapidly, the patient passing at once into this state, which is then called *acute* or *primary dementia*; or it may be the result of years of insanity or brain-disease, and is termed *chronic* or *secondary dementia.* In such people we find loss of memory, inability to revive the relations of feelings and ideas —not emotional disturbance, but rather an absence of all emotion.

As regards the bodily symptoms, almost every variety of insanity is ushered in by sleeplessness; sleep being deficient or altogether absent, perhaps for days, according to the acuteness of the attack. This indicates a disturbance of the brain-circulation, which is also shown by heat and pain of head, injection of the conjunctivæ, and throbbing of the carotids. There may be excessive vascular action even when the insanity is the reverse of what is sometimes termed 'sthenic,' and the general condition of the patient is one of anæmia rather than hyperæmia.

It has been said that the mental symptoms of insanity are accidental, that they do not indicate the pathological conditions, but depend on the state of the body, and that no classification of the forms of the disorder ought to be based on them. But it is perfectly certain that the brain of a man suffering from melancholia differs altogether from that of one in acute mania. In the former there is a scanty generation of nerve-force, which is insufficient to reach the remote channels and plexuses of the brain. There is not a general incoherence and confusion of ideas, and the patient can converse rationally on many topics. His feelings are those of pain and not of pleasure, because pains in general are more intense than pleasures in general,[1] and the former are called into consciousness by the feeble nerve-currents, while the latter are not. In what is termed mania we may have every shade of feeling displayed, from gloomy and suspicious irascibility to great hilarity. Feelings of anger and resentment are called up without the controlling power of reflection and judgment, such as would prevail were the whole brain at work, and the higher faculties and feelings co-operating and in relation with the lower. This, again, may be due to a want of nerve-force, or more frequently to an undue expenditure of it, as may be seen in the irritability of an over-tired child. What we may call the more automatic and less complex feelings of fear and self-love are evoked, while there is not force and pressure enough to supply the rarer and more remote qualities of comparison and reasoning, which require the combination and union of the highest portions of the brain. If there is an increased and accelerated blood-flow, great hilarity and self-satisfaction may be the result, yet with perfect incoherence of ideas, owing to all the relations of the brain-centres being interrupted by the tumultuous or impeded circulation, and the excessive nervous discharge. And in dementia the very opposite may be witnessed. The supply of force is reduced so low that there is an absence of all ideas; memory, at any rate of recent events, is lost, and only the well-marked occurrences of earlier life are recalled.

That the mental symptoms are to be by the pathologist altogether disregarded, and that they are of no assistance in the appreciation of the pathological condition, is a most extraordinary assertion. These symptoms do not depend on the state of the body generally, but on that of the brain, and as accurately indicate the condition of the latter as the breathing indicates that of a lung. The brain in insanity is the *pars affecta*, the unsoundness is the symptom; and when we see in the same individual at one time mania and at another melancholia, we may be sure that the condition of brain at the one period is not the same as at the other, though originally one cause may have lighted up the malady.

DIAGNOSIS.—Accuracy of diagnosis is specially important in insanity, owing to the legal and social results which flow from it, and because the restrictions on liberty which may be necessary for proper treatment cannot be resorted to until a diagnosis has been conclusively established. The direction of the investigation will be different, according as the condition may be the result either of incomplete development, or of disablement or perversion by disease. Where *imbecility* is in question, it may often be necessary to take several opportunities of examining the patient. This condition always implies intellectual defect, though great moral depravity is often the predominant symptom. It is therefore necessary to ascertain whether any or what kind of occupation has been attempted, and what amount of incapacity has been shown, and whether the individual has proved capable of profiting by such education as he has received. Adults in ordinary circumstances ought at least to be able to read, write, and count. The decision rests on whether such capacity has been shown as is required in the ordinary conduct of life. To form a correct opinion in cases of *acquired insanity* is often a very difficult matter. The relatives of the patient often obstruct rather than aid the inquiry. They are generally divided in opinion, and this may be partly an aid and partly an obstruction; but great care is required to avoid taking part at first with either side. Before seeing the patient it is proper to make what inquiry is possible into the hereditary history of the family, and the nature of the diseases or injuries from which the patient may have suffered, including any previous attacks of insanity. The ordinary habits, disposition, tastes, and occupations must be ascertained, and also the present habits, disposition, tastes, occupations, amount of sleep, and general bodily health. The mental symptoms, such as suspicions, delusions, or loss of memory, which have suggested the allegation of insanity, must also be inquired into; and special attention must be paid to any indication of the change of conduct or disposition which is so characteristic of the advent of mental disease. A reference to the articles descriptive of the forms of insanity will show the importance of all these points. In the whole investigation care must be taken to avoid accepting mere *ex parte* statements, and as much information as possible should be obtained by the inspection of letters or other documents written by the patient. Sometimes the conduct of the patient renders it difficult to obtain an interview, and care must be taken not to overstep legal limits in the attempt. If the physician has to see the patient in the presence of other persons, it is a necessary precaution to make certain that he clearly understands whom he is to examine. In obtaining the interview a certain amount of stratagem may sometimes be resorted to; but it is best that the physician should be introduced by a friend in his true character as a doctor, and on no account should any false statement be made. As a mere matter of expediency it will be found that any deviation from this produces more evil than good. If the interview takes place in the patient's home, valuable information may frequently be obtained by observation of the order or disorder which prevails. The condition of the furniture, the state of the patient's clothing, his manner towards the rest of the household and their bearing towards the patient, ought to be noted. The patient's physiognomy, the condition of the pupils, and any gesticulations or convulsive or tremulous movements, must be observed. In conversation it is well to get as soon as possible to the subject of the patient's health, as it relieves many necessary questions of their offensive character. Eccentric ideas ought not to be combated more than may aid in making the patient disclose them fully; and everything tending to show the presence or absence of delusions, irrational suspicions, or loss of memory, ought to be elicited. Many other points will probably be suggested by the course of each inquiry; and the importance to be attached to them, as well as to those just mentioned, must be decided by a careful study of how far they are included or excluded by the known symptoms of any of the various forms of insanity.

---

[1] *See* Herbert Spencer, *Principles of Psychology*, vol. i. p. 602.

ÆTIOLOGY.—We now pass to the causes of insanity, which are usually spoken of as *predisposing* or *exciting*; in many cases both combine in the causation of the disorder.

The great *predisposing* cause is an inherited disposition to neurotic disorder—one difficult to estimate and, indeed, to discover, owing to the care with which it is concealed, but the importance of which cannot be questioned. It has been adverted to in the second section of the pathological conditions, and will again be noticed. *See* INSANITY, Varieties of.

When we speak of such predisposing causes as *sex*, *age*, and *condition of life*, it is evident that they can only be called causes in the sense of being concurrent conditions, in some of which a man or woman is more likely to become insane than in others.

What are the relations of *sex* to insanity? Referring to statistical tables, we find that in the Report of the English Commissioners in Lunacy for the year 1892 there were under treatment in asylums at the end of the year 1891, 29,293 males and 34,698 females. There were admitted during the year (not reckoning re-admissions or transfers) 8,233 males and 8,690 females, while in the same period there died 3,560 males and 2,924 females. The preponderating number of females under treatment is probably due to the fact that the mortality among them is far less than among males, and consequently they accumulate in asylums. The difference in the number of the two sexes who become insane is probably not material, but it seems that the males are the larger number, or, looking at the difference in the mortality, they would fall below the number of the females further than they do.

With regard to *age*, we find that the tendency to insanity increases with the development of brain and mind. In the first decade of life it is rare. In the second, which includes the period of puberty, it is more common, but not so much so as in the next. The period between 25 and 40 years is that in which the greatest number of cases arise, and is that of the highest development and working power. After this the number declines in each decade, as before it rose. With the age the character of the insanity varies. In youth it is displayed in violent and paroxysmal mania, sometimes in acute dementia, and cataleptoid states. There is great motor disturbance, and emotional rather than intellectual aberration. Rarely are the young melancholic. In the prime of life there is active mania with delusions and intellectual insanity, and at this period we meet with the most acute forms. Later, melancholia prevails; while in old age weakness of mind, passing into fatuity and second childhood, indicates the general decay of the brain and nervous system.

As to the *condition of life* in which insanity is most frequently found, there is not much to be said. That it occurs more frequently in civilised than in barbarous countries may be assumed without recourse to figures, because in the former mind and brain are more complex, and therefore more prone to disorder. It is, however, the failures and vices of civilisation that bring about the great mass of insanity And of these the chief is *poverty*, with all its attendant physical evils of insufficient food and wretched dwellings, and moral evils of anxiety and degradation. Next to poverty, and closely bound up with it, is *drinking*, which among the working classes plays a fearful part in the causation of the disease. Among the predisposing causes of insanity included by the International Congress of Alienist Physicians in 1867 are, besides those already enumerated, consanguinity; great difference in the age of the parents; influence of the soil and surroundings; convulsions or emotions of the mother during gestation; epilepsy and other nervous affections; pregnancy, lactation, menstrual periods, critical age, puberty, venereal excess, or onanism. We may add to these, damage received at birth owing to difficult parturition.

The *exciting* causes of insanity are usually divided into *moral* and *physical*. Among the former we may reckon domestic trouble and anxiety, mental shock, over-work, religious excitement, political excitement and war, and disappointment. Concerning such little need be said. They may vary in duration, some quickly bringing about insanity, others persisting for years before that result is reached. For the most part, those who are affected by such causes are already predisposed by hereditary taint, by a neurotic temperament, or by being at one or other of the critical periods of life.

Among the *physical* exciting causes are some which are both exciting and predisposing—for example, intemperance and epilepsy. These may be the immediate precursors of an attack; as well as agents causing a predisposition to the disorder, by being repeated through a series of years. Other physical causes are parturition, menorrhagia, amenorrhœa, and various other ovarian and uterine ailments; acute febrile diseases and chronic illness, producing exhaustion; constitutional diseases, as gout, ague, or syphilis; disease of heart and vessels; exposure to great heat or cold; lead and other poisons; anæmia; blows on the head, and organic affections of the bones of the cranium, or the various parts contained therein.

Classification.—Almost every writer on insanity has suggested a special classification of its forms, and the majority have founded their suggestions either on the ætiology or on the symptomatology of the disease. Of those based on symptoms no classification is simpler than Griesinger's: (1) states of mental *depression*; (2) states of mental *exaltation*; (3) states of mental *weakness*. He placed general paralysis and epilepsy apart as mere complications of insanity. His groups, therefore, correspond broadly with the old divisions of *Melancholia*, *Mania*, and *Dementia*. The ætiological classification most widely known is that of Morel. He divides the forms into six: (1) *Hereditary* insanity, including congenital nervous temperament, moral and impulsive insanity, imbecility, and idiocy; (2) *Toxic* insanity, including conditions caused by insufficient or injurious food, poisons, or noxious air or water; (3) *Hysterical*, *epileptic*, and *hypochondriacal* insanity; (4) *Idiopathic* insanity, dependent on disease of the brain or its membranes; (5) *Sympathetic* insanity; and (6) *Dementia*, or the condition of terminative enfeeblement. For any systematic study of the subject, it is obvious that some symptomatological grouping, based on the characters of the mental manifestations, must be necessary. It has, however, been maintained that it is impossible, either on this or on a purely ætiological basis, to found groups which have more than an artificial relationship to one another. And there is some truth in this criticism. But, though the ties which bind the psychological groups together may be in a sense regarded as artificial, it is found in practice that the associated conditions exhibit a considerable amount of intimate natural connexion.

At the International Congress of Alienists in 1867 the following classification was laid down, intended to combine the ætiological and symptomatological methods: 1. *Simple Insanity*, comprehending mania, melancholia, monomania, circular insanity, moral insanity, and the dementia following these forms. 2. *Epileptic Insanity*. 3. *Paralytic Insanity*. 4. *Senile Dementia*. 5. *Organic Dementia*. 6. *Idiocy*. 7. *Cretinism*.

The first class, it will be observed, comprises all the varieties which may be regarded as merely functional; the others are mostly associated with permanent structural lesions.

No classification which has been proposed can be regarded as altogether satisfactory. This is partly owing to the fact that the true nature and limits of insanity itself have been very imperfectly recognised. The essence of the condition is, of course, the manifestation of disease through some deviation from the healthy standard of mental action. It is a condition of mental unhealth analogous to bodily unhealth. But we must not allow ourselves to imagine that there is a class of morbid mental manifestations which are independent of the condition of the physical frame. The truth is, that there is no pathological condition of the individual in which both mind and body are not affected; but in some diseases the mental symptoms come into prominence, in others the physical. The notion, not yet altogether exploded, that there is something in insanity altogether distinct from bodily disease, arose from the belief so long prevalent that mental action is independent of physical conditions, and from the fact that the study of insanity has been and still is too much dissociated from the study of the rest of cerebral pathology. Acting upon the broader and truer views, attempts have been made by Schroeder van der Kolk, and others, to introduce a more natural system of classification. Such attempts have proceeded on the recognition of all mental symptoms as phenomena whose nature cannot be ascertained without a full consideration of the physical symptoms of disease by which they may be accompanied. Dr. Skae proposed a classification based on the belief that every mental disorder bears a relation to some bodily disease—acute or chronic—analogous to what the delirium of fever does to the fever in whose course it is manifested. The detailed list which he offered was, however, admittedly imperfect; and it is likely that any satisfactory classification on this principle will only be arrived at after a much closer study of the mental symptoms of disease than has yet been given to them. But Skae deserves the credit of having given the most powerful impulse to the purely medical, as opposed to the metaphysical, mode of studying insanity. In furtherance of this, some progress has been made by Clouston, Batty Tuke, and others, who have published careful monographs of some of the more prominent forms. If by such means we can group together conditions which are similar, not only in their mental but also in their physical characters, we obtain units which may ultimately contribute to the building up of a more perfect system, and can never be altogether disregarded by classifiers in future. Most of the attempts which have been made to describe such groups must at present be regarded rather as valuable suggestions than as well-established clinical and pathological species. For the purposes of this work it has been considered best to describe, in the present article, the various phases of insanity which have been regarded as of special importance, without regard to the principles which underlie their conception; and afterwards to discuss the various well-marked forms of the disease under their several heads, alphabetically arranged.

Prognosis.—The general prognosis of insanity will depend (1) on the duration of the existing disorder. Perhaps the best established fact of all is, that the chances of recovery diminish in direct proportion to the duration of the malady, and that it is consequently of the utmost importance to place a patient early under adequate and appropriate treatment. If a twelvemonth elapses without appreciable improvement, the chances are decidedly unfavourable. If delusions or hallucinations remain fixed and unchanged at the end of a year, especially if there be hallucinations of hearing, the prognosis is bad. The chief exception is where there is marked melancholia. Patients will recover from this after long periods; whereas such recoveries are seldom found in insanity when depression is absent. (2) When the cause of the insanity has been of long duration, the prognosis is less favourable than when it is a passing or accidental cause. (3) Is the prognosis unfavourable in hereditary insanity? So much of the so-called simple insanity is hereditary, that we must admit that recoveries from it are not infrequent, for it is from this simple insanity that recoveries chiefly take place. Hereditary insanity is developed by very slight exciting causes, and thus the prognosis is often favourable, and recovery takes place; but relapse is to be feared, and the prognosis in a second or third attack is not nearly so good. In this hereditary insanity, too, we frequently meet with the cases of recurring and 'circular' insanity, the progress of which is most unfavourable. Both Ray and Griesinger have remarked that the prognosis in hereditary insanity is favourable only where the individual has previously been of normal mind. When he has always been eccentric or semi-insane, and undoubted insanity at last manifests itself, the prognosis is very bad. (4) The more acute the symptoms, the greater the cerebral disturbance and insomnia, the more favourable is the prognosis, if the case is recent. Conversely, the prognosis is bad when there is little bodily disturbance, where sleep is present, the appetite normal, and the secretions unaffected, especially if persistent delusions or an entire moral change are found. (5) As all deviation from the ordinary mental state and disposition is indicative of insanity, so any return to it is a favourable sign, however trifling the circumstances may be. (6) Improvement, however slow, is a good sign if it be progressive. So long as this goes on, recovery may take place; but many patients improve up to a certain point, and then go no farther. (7) The age of the patient must be considered. Young people recover in greater numbers than those advanced in life. The latter recover if their insanity be melancholia; but, if it be mania, with hallucinations and delusions, and obscene conduct and ideas, recovery is rare, especially if the memory is impaired, and signs of approaching dementia are present. (8) All periodicity in the disease, such as exacerbations and remissions on alternate days, is unfavourable.

Treatment.—Only a few general remarks on treatment need be offered here. Our objects should be to restore to health the disordered brain, to cause the incessant waste to cease, to promote a storing and not an expenditure of nerve-force. The brain must be nourished by healthy blood. The quantity of the latter when in defect must be increased; when its quality is in fault it must be improved; when the blood-flow is in excess it must be checked; while all causes of disturbance reacting upon the brain from other organs of the body must be removed.

It is not to be forgotten that powerful effects are produced throughout the nervous system, both in the lower and higher centres, by what has been termed 'inhibition.' By the diversion of nervous action from one channel to another, considerable influence may be exercised.[1] Emotional excitement may be diverted into motor or intellectual channels; or, by other emotional stimuli, may be counteracted or arrested. Intellectual or ideational troubles may be diverted by emotional longings, or by counteracting intellectual pursuits. And for all this certain adjuncts are necessary. Painful emotional distress, with the idea of impending ruin, is perpetually fostered by the sight of the loved faces of wife and children: the patient must therefore be removed from them. Outbursts of anger are constantly directed against those most familiar, and delusions correspond. These must be abolished by residence among strangers. Great as is the need of medicinal treatment in many cases, it is not so universally demanded as is the removal of the sufferer to fresh surroundings. We try again and again, in apparently the most promising cases, to effect a cure at home, and we fail. The necessity for early treatment in insanity is dwelt upon by every writer; and the treatment, when insanity is once fairly established, only begins after the patient is removed.

---

[1] Dr. Lauder Brunton, On Inhibition. *West Riding Asyl. Med. Reports*, iv. 179.

The first questions to be solved are how the removal is to be effected; and to what place the patient is to be removed. In the majority of cases, especially in the case of the poor, no doubt can arise—an asylum is the only place open to them, because the friends being poor cannot afford any other plan of treatment, and are compelled to have recourse to the public asylums of the land. An asylum is necessary for many because the patient is dangerous to himself or others, or would incessantly struggle to escape from a less guarded dwelling. But there are some patients who may be cured out of an asylum. Some recover from acute but transitory attacks of delirious mania very rapidly, much as do the sufferers from delirium tremens; and, if measures of safety can be taken, we may watch such for a few days and perchance they may recover without removal. Many persons at the very outset of insanity may be cured by removal and judicious treatment, if their friends will only open their eyes and acknowledge the threatening evil, and not wait, as they so often do, till compelled by circumstances to interfere. Such patients must not be sent abroad or out of reach, must not go alone, or without able or skilled companions. They may go from place to place, or to a friend's or medical man's house. Fresh scenes and faces, and the cessation of work or worry, will often effect a cure. But they must be people able to walk out in public thoroughfares, and to live in houses under ordinary precautions. Where they cannot walk in public, and cannot live in a house without its being converted into a prison, they ought to go to an asylum, where there are grounds for exercise, and where facilities for escape are not always suggesting attempts. Patients' friends constantly make a mistake: they keep the patient out of an asylum at the time asylum treatment would cure him, and send him there when all hope of cure is over, and when, as a chronic lunatic, he could be just as well taken care of outside one.

With regard to medicinal treatment little need here be said. The medicines appropriate to each form of insanity will be spoken of under the different heads. An important group consists of sedatives and hypnotics; and to those formerly in use, as the bromides, opium, chloral, and Indian hemp, there have been added various new drugs, as hyoscine, hyoscyamine, paraldehyde, and sulphonal—the last two the most valuable of all, in the writer's experience. Speaking generally, it may be said that in the depressed and melancholic cases the preparations of opium are of the greatest service, not only for procuring sleep, but for allaying the terrible feeling of gloom which prevails in the daytime, and especially on first waking from sleep. The efficacy of opium here is not that of an hypnotic only. It acts as a stimulant during the waking hours, and for this it has no rival. Next to it in melancholia paraldehyde deserves to be placed. In the opposite class, the excited or maniacal, opium rarely does good and may do harm, preventing instead of producing sleep. In place of it the bromides with or without chloral may be given, or hypodermic injections of hydrobromate of hyoscine. The nauseous taste of paraldehyde makes it difficult to administer; but sulphonal is tasteless, and, if mixed with food, will not be discovered. Besides these, the chief medicines required are tonics, the preparations of iron being the most valuable. Constipation must be carefully prevented.

Good and abundant food is an essential in the treatment of the insane. Stimulants are required in many cases, particularly the depressed and anæmic forms; but in the opposite, though often useful, they in some cases produce or increase excitement, especially in the early stage. With the food tonics should be given; and those best suited are, in the writer's experience, the mineral rather than the vegetable, and chief of all the preparations of iron and arsenic.

G. F. Blandford.

INSANITY, Morbid Anatomy of.

Methods of Examination.—In order to examine any brain specimen thoroughly it is advisable to employ two methods: (1) freezing, cutting, and staining fresh portions with aniline black; and (2) hardening for some weeks in one or other of the well-known solutions—such as Müller's. The first is the essential process, the second is mainly useful as confirmatory of its results. The teazing-out method is valuable for the observation of cell-structure. Full directions on this subject will be found in Dr. Bevan Lewis's *Manual of Examination of Human Brain.* By the freezing method sections can be submitted to the microscope in two hours, unchanged by the action of reagents, and, if necessary, can be at once photographed; by the hardening process larger areas can be examined, certain lesions are made more prominent than by freezing, and sections can be permanently preserved.

The morbid anatomy of the different structures will now be systematically reviewed.

1. **Calvaria.**—The calvaria is often found thickened, dense, heavy, or thinned. In recent cases of syphilitic disease and in general paralytics, it has been found inflamed, both tables thickened, the cancellæ enlarged, and the lacunæ full of granulation tissue. The dense skull is generally found in old-standing cases of chronic terminative dementia, and in epileptics. The inner table may present local indurations.

2. **Membranes.**—In treating of the membranes we would premise that in our opinion it is anatomically correct to speak of only two, the *dura* and the *pia mater.* No doubt exists as to the minute anatomy of the former; it is a thick, inelastic, fibrous membrane, containing vessels and lymphatics, and lined on its inner surface by flattened epithelium. The *pia mater* is a double membrane, the outer layer of which (the so-called *arachnoid*) covers the brain without folds, and bridges the sulci; the inner is applied to the surface of the convolutions, and dips into all the fissures and sulci. Between these two layers a rich plexus of blood-vessels and lymphatic spaces ramifies, the layers being intimately connected by large numbers of trabeculæ over the free surface of the convolutions, but being widely separated in the sulci and fissures, and in the basal cisterns. Thus we have a visceral and a parietal layer of the pia mater, neither of which is in itself, as is often stated, a vascular membrane. For the purposes of differentiation the former will be spoken of as the *arachno-pia*, the latter as the *visceral pia.* The space between the arachno-pia and the dura is now termed the *sub-dural* space (formerly the arachnoid cavity), and the spaces between the arachno-pia and the visceral pia will be termed the *pia-matral* spaces instead of the sub-arachnoid cavity. Thus from without inwards we have—

(*a*) Dura mater; (*b*) Sub-dural space; (*c*) Arachno-pia; (*d*) Pia-matral spaces; (*e*) Visceral pia; and (*f*) Brain-matter.

Lymphatic System of the Encephale. In order to have a clear conception of the results of morbid action in the membranes and brain-matter, the lymphatic system of the encephale must be studied. The visceral pia, whether on the surface of the convolutions or in the sulci, sends with each vessel a prolongation inwards surrounding it, and forming the *hyaline sheath* or *perivascular canal*, which can be traced to the ultimate ramifications. Every cell of the grey matter is encapsulated by a fine membrane, first described by Obersteiner, which is a ‘spur-like’ prolongation of the hyaline sheath. Starting from the cell, we have thus a capsule connected by a fine channel with the hyaline sheath of the vessel, which debouches into the pia-matral spaces (the so-called sub-arachnoid space), and these communicate directly with the basal cisterns—the cerebello-medullary, the inter-peduncular, that in front of the optic chiasma, the Sylvian, &c., with the ventricles, and with the wide pia-matral space in the spinal canal. The pia-matral spaces communicate with the sub-dural space by means of the Pacchionian villi. These organs, which are prolongations of the arachno-pia, protrude not only into the lymphatic spaces of the dura, but also into the longitudinal sinus, being separated in both instances by a fine membrane from the fluid contained in each class of vessel. This constitutes the main lymphatic system of the encephale, which, finding vent through all the foramina of the skull and vertebral column, maintains direct communication with the extra-skeletal lymphatics. But, besides this main system, there are reasons, chiefly founded on the observations of Dr. Bevan Lewis, for believing in the existence of what he calls a *lymph-connective system.* Scattered throughout the grey and white matter, but more specially arranged along the vessels, and in the outer layer of grey matter of the convolutions, are found cellular structures of two kinds: the one small, consisting of a readily stained nucleus with slight protoplasmic surroundings; the other large, consisting of a nucleus not easily stained in health, and a considerable protoplasmic body, sending out poles or processes of two kinds. One set of processes is numerous and is distributed throughout the neuroglia between vessels, cells, and fibres; the second is a single process, and runs directly to the perivascular lymphatic. Whether this is or is not a tube has not been yet determined, but the strong probability is that it is not canalicular. These spider cells, which were first described by Deiters, and go by his name, are held by Dr. Bevan Lewis to be the *scavenger* cells of the brain. He maintains his theory as to their function mainly on the ground that, whenever there is any special demand for the removal of the products of disease, as in inflammation, these bodies increase in size, their processes become distinct, which they are not in health, and present all the appearances of increased activity. Of this fact there can be no doubt, and there are many pathological analogies, *e.g.* the behaviour of the connective-tissue corpuscles of the lung in connexion with pigment, which give a general support to the theory. His has described an *epi-cerebral lymph-space* between the visceral pia and the brain-substance. Its existence is open to grave doubt. It is not demonstrable in healthy animals, and difficulty arises in endeavouring to explain how the fluid it is said to contain can reach the lymph-system in the pia-matral spaces.

(*a*) *Dura mater.*—The most frequent lesion of the dura mater is a morbid degree of adhesion to the skull; this is specially marked in general paralytics, and is the result of subacute inflammatory processes commencing in the subjacent tissues. It has occasionally, though rarely, been found thickened. Osteophytes have been noted in puerperal cases; bony plates have been recorded, and the falx has been found ossified.

(*b*) *Sub-dural fluid.*—The sub-dural fluid may be considerably increased, in which case the pia as a whole is much affected. Adhesions between the dura and the arachnopia are rare.

(*c*) *Arachno-pia.*—*Opacity* of the arachnopia is generally found to some extent in sane subjects after middle age, and is specially well marked in habitual drunkards. Considering that subjacent to it lie the principal lymph-conduits of a very active organ, it is not to be wondered at that some evidence should be left of the products of waste in the meshes of this delicate membrane even in healthy subjects. In many forms of insanity, *e.g.* acute idiopathic mania and melancholia, and in general paralysis, opacity is noticeable at a pretty early stage. In three cases of acute idiopathic melancholia, the subjects of which committed suicide within six weeks of the incidence of the condition, the writer found well-marked pearly or milky streaks, not implicating the whole layer, but showing themselves along the course of the veins; thus a purple and congested vein showed a narrow white band on each side of its exposed surface. This early indication is caused by transudation through the walls of the veins, the blood in whose main trunks, debouching into the sinus at an angle contrary to its current, is, particularly under conditions of disease, liable to be retarded. In 60 per cent. of insane subjects the arachnopia shows indications of diseased action. It may be gelatinous-looking, due to enlargement and distension of the pia-matral lymph-spaces by serous fluid; thick and opaque in consequence of the infiltration of exudation; and we occasionally find the parietal widely separated from the visceral layer, the trabeculæ having been stretched or destroyed. These appearances are specially well marked in cases which have been the subjects of prolonged attacks of excitement, whether in the form of mania or melancholia, and who have lapsed into terminative dementia. It may be noted here that, although mania is manifested by exaltation and melancholia by depression of feeling, both are expressions of excitement. The writer has met with instances where this membrane was not more affected than it generally is in sane persons, but these were for the most part cases in which the insanity had been of a true hereditary type, evidenced by simple delusional conditions uncomplicated by excitement.

Between the dura and the arachno-pia, so-called 'arachnoid cysts' or 'pachymeningitic' *false membranes* are often found. Both terms are erroneous: they are not cysts, they are not formed from any membrane, nor are they the result of inflammation. They are entirely due to extravasations of blood, probably produced during periods of cerebral excitement, and proceeding from the dammed-up vessels of the pia (*see* MENINGES, CEREBRAL, Diseases of). Such false membranes may be very extensive, occupying the whole superior and lateral aspects of a hemisphere, or they may be confined to a limited area; they may be tough and thick, or very thin, and so delicate as to render it difficult to lift them whole from the pia; or the so-called pachymeningitis may be only evidenced by staining of the dura mater by blood-pigment. Thin blood-clots have been occasionally found in the cavity of the pia, and between the visceral pia and the surface of the convolutions; but these were never so thoroughly organised as the false membranes between the arachno-pia and the dura. In the substance of the brain itself the writer has found in two cases very small clots about a line below the surface. In both these instances the cranium had been submitted to traumatic injury; in one of them vacuoles were shown containing blood-pigment.

The *amount of fluid* in the cavity of the pia is often greatly increased; we may measure as much as 12 ounces, but the more frequent quantity is from 2 to 6 ounces. Such large accumulations of fluid are generally found in cases where there has been brain-wasting, and is therefore compensatory. But it must be distinctly understood that, in recent and acute cases, fluid, whether in the cavity of the pia or in the sub-dural space, is the direct result of inflammatory processes and is in no sense compensatory; on the contrary, it may produce brain-atrophy by pressure. This is particularly well marked in general paralysis, in rapidly fatal cases of which condition there may exist considerable atrophy of one hemisphere, with extensive effusion into the sub-dural and pia-matral spaces. General paralysis is the result of sub-acute inflammation, either commencing in the pia and extending gradually inwards along the course of arteries and veins, or affecting the two regions synchronously. Under these circumstances the production of exudation is a necessary consequence. But in the case of idiopathic insanity the original seat of irritation is the grey matter. By idiopathic insanity it is intended to indicate the insanity which follows on the action of so-called 'moral' causes: grief, worry, anxiety, prolonged study, &c.—any emotion or mental action productive of prolonged excitation of the cells.

It is a well-ascertained fact that mental action is accompanied by functional *hyperæmia*, which is of course a necessary condition for functional activity. Functional hyperæmia is produced either by inhibition of the vaso-motor centre in the medulla, or by stimulation of the vaso-dilator centres, or possibly by their combined action. The expression of Crichton Browne may be accepted as a postulate: 'the amount of blood-supply to the brain and its parts is determined, not by vascular domination, but by the functional activity of the nervous tissues.' Functional hyperæmia is apt to lapse into pathological hyperæmia if the excitation or emotion is unduly prolonged, and develops more or less rapidly what is equivalent to the first stage of inflammation. The first microscopic indication of this condition is the presence of leucocytes, together with a very fine granular material, the broken-down nuclei of leucocytes and epithelium, and of small yellow masses of blood-pigment between the walls of the vessels and the hyaline sheath. The writer has noticed these appearances within six weeks of the incidence of acute idiopathic melancholia. The perivascular lymphatics become blocked by these morbid materials; bulge out unduly; and are distinctly dilated by exudation fluid, which cannot find its normal course of exit. Under these circumstances the outflow of lymph and of effete matter from the cell-capsule becomes impossible, or is very much impaired; fluid accumulates within it, and the cell suffers. In health the *reaction of the cerebro-spinal fluid* is alkaline; under conditions of disease it becomes acid, in consequence of the accumulation of the acid products of cell-waste. Thus the cell lies bathed in a poisonous fluid, and its functional activity becomes necessarily impaired or perverted. Roy holds that acidity of the fluid is sufficient in itself to produce and maintain hyperæmia. A certain proportion of this exudation finds its way to the pia-matral spaces by the sheaths, which become more or less seriously affected; but another portion of it becomes diffused throughout the substance of the convolutions, interfering with the normal relations of fibre and connective tissue. The brain becomes more or less œdematous. In the case of idiopathic insanity the inflammatory process extends outwards, and the pia mater becomes implicated. Following implication of its lymphatic apparatus we have *accumulation of fluid* in its cavities, which may extend to the sub-dural space. In the comparatively rare condition of inflammatory adhesion between the arachno-pia and dura, local accumulations occur on the superior aspect in both cavities. In whatever manner local accumulations occur, corresponding atrophy of the subjacent brain-substance is the result produced by pressure. The diffusion of the fluid products of inflammation commencing in the pia or in the grey matter is circumscribed inferiorly by the resistance offered by the connective tissue; and, as in an abscess, local inflammatory tension may exist in a hemisphere without implicating remote areas. These facts were fully illustrated by observations made in two cases which, during 1889, were trephined for the relief of symptoms of general paralysis. (See *Brit. Med. Journ.*, Jan. 4, 1890.) In one case the dura mater bulged and filled the hole after removal of the disc on the right side; on the left there was little or no bulging. The patient died seven months after the operation, from pneumonia; on examination, the right hemisphere was found much atrophied, with a large quantity of pia-matral and sub-dural effusion. The bulging points necessarily to pressure, as any merely compensatory fluid could exercise no such power.

General softening of the brain is due to œdema.

Blood-Vessels.—The blood-vessels, in addition to the changes already mentioned as occurring around them, are found tortuous, dilated, thickened, occluded, or aneurysmal. It is of importance to bear in mind that many of the arterioles of the cortex are terminal; that is, they do not anastomose, and are distributed to limited areas (Duret). No conclusion can be arrived at with safety as to the degree of vascularity by the appearance of *puncta vasculosa*, as the number and distribution of these spots are dependent on various accidental circumstances. Tortuosity is rarely met with. It has been reported as extreme in the vessels of the pia. Within the brain-substance the writer has noted vessels twisted and lying in a space, the lumen of which was much larger than normal: the sheath in fact was so much enlarged as to hold a corkscrew arrangement of the vessel. This was observed in epileptics. Increased vascularity is noticed in recent cases symptomatised by acute mania and acute melancholia, and in the early stage of general paralysis. But anæmia is more common in cases of long standing, and in many instances is due to the diseased or congested states of the vessels, to thickening of their walls, or to atheromatous deposits; in other cases to the condition of the general system. Thickening of the walls may be due to arteritis, which in specific cases may cause complete occlusion; and increase of the muscular coat, especially in chronic alcoholism, is of pretty frequent occurrence (B. Lewis). The opinion of this most careful observer must be held in respect; but it may be stated that, as regards other regions, the general opinion is that thickening of the muscular coat is more apparent than real, and that the appearance of hypertrophy depends on thickening of the fibrous tissues. Miliary aneurysms are not infrequent. Local atrophies are produced by implication of the terminal vessels by one or other of the morbid processes just spoken of. Adhesion of the visceral pia to the brain-substance is due to inflammatory changes in the vessels, and to consequent proliferation of the layer of Deiters' cells existing on the surface of the convolutions.

Nerve-Cells.—The morbid changes in the nerve-cells are most marked in the frontal lobes, and in the superior convolutions of the parietal lobes, which regions are in fact those mainly implicated in insanity. In the dependent portions of the hemispheres, in the occipital lobes, and at the base of the brain, morbid changes of any kind are rarely noticed.

The special morbid conditions of the nerve-cells are: (α) Pigmentary, granular, or fuscous degeneration; (β) Hypertrophy; (γ) Calcification.

(α) A certain degree of *pigmentation* is almost invariably found in the cells of the fourth layer of sane adults. The writer has examined these structures in twelve cases taken casually from the mortuary of an infirmary, and found it more or less observable in all cases over thirty years of age; but it was specially well marked in cases dying from pneumonia or bronchitis. The writer has examined the brains of dements where no evidence of pigmentation could be found. But an extreme degree of pigmentary, fuscous, or granular degeneration is a very common condition in many forms of insanity, particularly senile mania and general paralysis. Major distinguishes three stages: (1) The cells lose their sharply defined contour and become swollen or inflated; the axis-cylinder and apical processes usually remain intact, but the protoplasmic processes disappear, and the cell becomes rounded off; the nucleus becomes swollen, more or less round or oval, and displaced, while it and its nucleoli are more easily stained than in the normal state. (2) A deposit of granules takes place at the base of the cell, and gradually permeates its whole structure. (3) The cell goes on to destruction, breaking down and shrinking, leaving the nucleus surrounded only by a mass of granules, apparently of a fatty nature, forming a gap in the cerebral tissue previously occupied by the swollen cell; still later the granules entirely disappear, leaving the nucleus free. He has not observed the nucleus actually undergoing disintegration, but often no trace of it is to be found in the mass of granules left by the degenerated cell. Bevan Lewis's views on these changes are fully stated in his *Text-Book of Mental Diseases.*

(β) *Hypertrophy* of the cells of the fourth layer has been observed in senile atrophy and general paralysis. As the name implies, they are large, and swollen in appearance, often presenting unpigmented granular masses in their interior.

(γ) *Calcification* of the cells by the deposit of phosphate of lime within their walls has been observed, according to Blandford.

The cells are found *vacuolated*, and the nucleus may present a clear diaphanous spot.

In almost all cases of old-standing terminative dementia the protoplasmic poles are either lost or materially diminished in number. This, along with the changes brought about by inflammatory processes and œdema, interferes with, or destroys, the relation of specialised areas.

Neuroglia.—The connective tissue of the brain undergoes inflammatory changes of a subacute or chronic nature, with the results of which we are familiar as more or less diffused *sclerosis.* In many forms of insanity the Deiters' cells along the course of the vessels and the outer layer of grey matter show indications of great activity. They, as well as the smaller cells, become increased in number, and the poles assume an amount of distinctness unnoticeable in health, staining deeply, and being traceable for many fields of the microscope. A meshwork is formed, destroying or displacing the normal nerve-fibres, and in the grey matter causing such a degree of homogeneity of structure as to make it stain as if it was composed of one tissue. In general paralysis, throughout the white matter the smaller cells are immensely proliferated, and along the course of blood-vessels the increase may be so great as to almost entirely hide them.

General sclerosis has only been observed in one case, which is fully detailed in the *Journal of Anatomy and Physiology*, May, 1873. In a hydrocephalic epileptic idiot (whose brain weighed sixty ounces) the hemispheres differed in weight; the left being 23½ ounces, the right 30¼ ounces. In the heavier or hypertrophied side, the nerve-fibres were found lying in fasciculi consisting of from four to six strands; these fasciculi were widely separated from one another by a clear, finely fibrillar plasm, in which nuclei existed, somewhat larger than normal.

Disseminated or *partial sclerosis*, or *grey degeneration*, is a lesion frequently met with in the brains of old-standing cases of insanity, especially in general paralysis. Its most frequent seat is the white matter of the motor tract; less frequently it is met with in the hemispheres. In the pons Varolii, medulla oblongata, and spinal cord of epileptics, patches of this disease are of common occurrence and in an extreme degree. When a fine section of nerve-tissue affected by this disease is examined by the naked eye, circumscribed opaque patches can be seen. In coloured sections these tracts are strongly tinted. As a rule, they are found contiguous to a vessel whose nuclei are much proliferated, and around which considerable proliferation of the nuclei of the neuroglia exists. Under the microscope, the nerve-fibres are seen to be partially or completely atrophied; the axis-cylinders and sheaths are destroyed; and the field is occupied by a finely molecular and fibrillated material, embedded in a cloudy homogeneous plasm. In this matrix the proliferated nuclei exist, somewhat enlarged, sometimes slightly granular in appearance;

but around the implicated spot they are to be seen in much greater quantity, and not actively diseased. The atrophied nerve-fibres occasionally project raggedly into the grey matter, where they are lost. Rokitansky believes this to be essentially a primary increase of the neuroglia; Leyden thinks it occurs secondarily to the atrophy of nerve-fibres; while Rindfleisch and others are of opinion that the first stage is marked by proliferation of the nuclei of the vessels, which is followed by an increase of the neuroglia and the development of a morbid plasm, which is, in all probability, modified neuroglia.

Secondary Lesions.—The two most important secondary lesions are *miliary sclerosis* and *colloid degeneration.* The former was first described by the present writer and Dr. Rutherford, and was ascribed by them to changes in the nuclei of the neuroglia. This theory must be abandoned; and the opinion of Dr. Bevan Lewis that it and colloid degeneration are due to myelin changes appears to be correct. The term does not properly indicate the pathological condition, but it has held place so long as to be generally accepted as indicating a certain lesion. Miliary sclerosis appears as unilocular, bilocular, or rarely multilocular spots, of a somewhat luminous pearly lustre, confined to the white matter, and consisting of molecular material with a stroma of exceedingly delicate colourless fibrils. 'In the immediate neighbourhood of these patches we find the nervous tissue in a state of parenchymatous degeneration, which, resulting in a destruction and atrophy of the essential elements, becomes the site of a *genuine sclerosis.* . . . The patch undoubtedly consists of altered myelin exuded in droplets from the medullated fibres and coalescing more or less completely' (Bevan Lewis). Colloid bodies are produced by analogous conditions.

J. Batty Tuke.

INSANITY, Varieties of.—In this article various forms of insanity will be described under separate heads. Dementia, General Paralysis of the Insane, Mania, and Melancholia will be found in other parts of the work.

1. **Alcoholic Insanity.**—The conditions included under this head must not be confounded with what is called dipsomania. In the latter affection the indulgence in alcohol is a symptom, and not necessarily a cause; while here the insanity is always a direct result of some form of alcoholic poisoning. It is met with in three forms—namely, *acute alcoholic insanity*, *chronic alcoholic insanity*, and *delirium tremens.*

Acute alcoholic insanity seldom occurs except when there is an hereditary tendency to mental disturbance, or when the cerebral energies have been impaired by excesses, traumatic injury, or over-work. Where all these predisposing causes exist, it may not require a large dose of alcohol to bring on an attack. The most frequent form of the affection is violent maniacal delirium, known as *mania a potu*, with a tendency to homicidal acts. In some cases the mental disorder takes the melancholic form, and it becomes necessary to guard specially against the strong suicidal tendency which generally characterises it. Unless the brain has been weakened by repeated attacks, both forms are curable and generally of short duration. The treatment is the nourishing, non-stimulating regimen detailed in the articles on Mania and Melancholia.

Chronic alcoholic insanity is one of the results of chronic alcoholism, and there is no condition which better illustrates the 'solidarity of the psychical and somatic functions of the nervous system' and the interdependence of their morbid manifestations. The physical symptoms are fully described in the article on Alcoholism; the mental symptoms are generally present from the beginning, though not always prominent enough to attract special attention. The sleeplessness, so characteristic of commencing mental disorder, is an early symptom; then restlessness and depression, with suicidal tendency, sometimes passing rapidly into complete dementia, but generally passing gradually through a course of moral and mental degradation, which progresses step by step with the symptoms of failure of physical nervous power. The affection presents many points of resemblance to general paralysis of the insane, and is in some cases only to be distinguished from it by obtaining evidence of alcoholic poisoning, and by the persistence of the mental depression, which is seldom more than a transitory symptom in the general paralytic.

Delirium tremens is described fully under the heading of Alcoholism; but it is proper to note here that, after the acute symptoms of that disease have passed away, there is sometimes left behind a state of subacute insanity of a characteristic nature. At first suicidal symptoms are apt to appear. Suspicions of poisoning, fear of impending evil, and hallucinations of hearing are also frequent. The treatment required is constant companionship of a trustworthy attendant, exercise, fresh air, and change of scene, with attention to every ordinary means of restoring the functions to a healthy state. Under proper treatment the prognosis is favourable.

John Sibbald.

2. **Amenorrhœal Insanity.**—Mental derangement is often accompanied in females by suppression of the menses. But in many such cases the insanity cannot be called amenorrhœal, as the cerebral and uterine disorders may only be associated as both symptomatic of some debilitating cause

affecting the whole system. Then the mental condition is usually the depression produced by anæmia. But there is a mental derangement directly resulting from sudden suppression of the catamenia, to which this distinctive name is not inaptly applied. Here the insanity takes the maniacal form. It is sometimes ushered in with urgent febrile symptoms, in which case the mania assumes the acutely delirious character. Where general febrile disturbance is not prominent, the mental condition is more simply maniacal, and sometimes does not get beyond mere irritability with delusions. The pathological condition must in either case be regarded as mainly a hyperæmia of the brain.

Treatment.—This must be directed towards the restoration of the arrested discharge. If the patient be seen at the commencement of the attack, the hip-bath and a gentle purgative may recall it. If the menstrual period has passed, the attention of the practitioner must be devoted to the relief of the more urgent symptoms. If the symptoms of cerebral congestion are distinct, leeches will probably be found useful, locally—behind the ears, or to the womb. Regular action of the bowels should be secured, but active purgation should be avoided. The food ought to be easy of digestion, and care should be taken not to let it be deficient in quantity. If the mental excitement is great and long-continued, it will necessarily produce considerable exhaustion, and the condition of the patient after recovery from the mental excitement will depend very much on the extent to which the strength has been supported during the continuance of this strain. The re-appearance of the catamenia generally implies recovery of mental health; but cases occur where prolonged amenorrhœa leads to a chronic maniacal condition, ultimately passing into hopeless dementia.

John Sibbald.

3. **Choreic Insanity.**—There appears to be an intimate connexion between the pathological basis of chorea and a certain disturbance of the mental functions. The physical and the mental symptoms, however, do not necessarily correspond in intensity. Sometimes, where the convulsive symptoms are very severe, the mental condition is merely one of dulness, apathy, or irritability. In children it shows itself generally in a maniacal restlessness, accompanied by delirium of a peculiarly automatic character. It is frequently associated at all periods of life with the rheumatic condition, and hence it has by some authors been called rheumatic insanity. It generally commences with sleeplessness and delirious excitement of a remittent character, which is sometimes accompanied by violent convulsive effort. As the excitement passes off, delusions of suspicion are apt to arise, and these are strangely associated with an apathetic mental condition. In the acute form the prognosis is favourable, recovery generally taking place in from four to eight weeks. The chronic form is apt to pass into dementia.

John Sibbald.

4. **Epileptic Insanity.**—*See* Epileptic Insanity.

5. **Feigned Insanity.**—Insanity may be feigned in order to escape the obligation of duty, or the consequences of crime. If manifested at a time when its recognition might be a benefit to the individual, it becomes necessary to test its reality. It must not be rashly inferred in any case that insanity is feigned; for it sometimes results from the excitement consequent on a sense of guilt or the shock of a false accusation; or it may arise coincidently but independently of such conditions. The best preparation for making a satisfactory examination in such a case is a familiar acquaintance with the appearance and conduct of persons undoubtedly insane. A person feigning insanity must, to be successful, simulate some known form of the disease; and as each form presents a more or less definite group of symptoms, an impostor is apt to reveal the truth by omissions or by additions inconsistent with the part that he attempts to play; but the mistake generally made by the impostor is to over-act the part. The inquiry may, of course, assume various aspects. A person may pretend to have been insane *at the time a certain act was committed.* Here it is to be remembered that the insanity, if real, would not probably have been confined to the time of the commission of the crime; and some evidence of premonitory symptoms previous to the act would probably be found. In such cases it is proper to regard want of motive as so far an indication of insanity; but when the supposition of a sudden mental perturbation is put forward, some reason would have to be shown for its occurrence; and some history of the occurrence of cerebral injury, or of previous attacks of insanity, epilepsy, or other cerebral affection ought to be forthcoming. A person feigning to be insane *at the time he is examined* must endeavour to present symptoms of either mania, melancholia, monomania, dementia, or imbecility. When the symptoms arise suddenly, simulation of the maniacal condition is generally attempted. The exertion which this entails will, however, generally compel an impostor to exhibit symptoms of fatigue, and even to sleep, when the true maniac would exhibit persistent excitement. The raving also when feigned may be recognised as hesitating and premeditated. Forgetfulness, which is generally assumed by the impostor, is an infrequent symptom of mania, except when it occurs in the course of general paralysis, and this is a disease whose other symptoms could scarcely be simulated. If melancholia or monomania

be feigned, the chief facts to be borne in mind are that such conditions, when real, are very unlikely to arise suddenly where there are no symptoms of bodily disease to account for them; and that they are usually characterised by a tendency to conceal peculiarities, or at least not to push them ostentatiously forward. Dementia never occurs suddenly without evident cause. Cases sometimes occur in which insanity is only partially feigned. Young criminals frequently try to exaggerate the signs of the intellectual weakness which is so generally mingled with their moral depravity, in hopes of obtaining a relaxation of discipline, or a change from a prison to an asylum. Such cases are often full of difficulty. The principle which ought to regulate our action is to avoid the continuance of punishment when disease or mental deficiency renders it useless. Before deciding upon the reality of any doubtful case of insanity, all the physical conditions of the individual, such as the amount of sleep, the state of the pulse, skin, tongue, and digestive system generally, the conduct and the state of health immediately preceding the signs of insanity, should be ascertained. The effect of remarks made within hearing of the suspected person should be observed; one who proclaims his own insanity should be distrusted. And the medical history of the family and of the individual should be inquired into, with a view to disclose anything which might have caused insanity or predisposed to it. JOHN SIBBALD.

6. Gastro-Enteric Insanity. — The emotional condition is well known to be to an appreciable extent dependent on the state of the *primæ viæ*; and where the nervous system is predisposed to derangement, certain affections of the liver, stomach, and bowels seem sufficient to produce insanity, and to stamp it with a special melancholic character. In addition to the mere depression caused by anæmia, there is associated with such affections a peculiar anguish of mind, and tendency to self-accusation, which is often of the most distressing nature. Refusal of food is frequently a prominent symptom. The intellectual perversion is often slight, and seldom so prominent as in other forms of acute insanity. Relief of the bodily symptoms is generally accompanied by a return to sanity. The affections which have been most frequently observed to produce this form of melancholia, are hepatic congestion, irritation and catarrh of the mucous membrane, constipation, stricture, or other causes of distension of the viscera, and pressure upon the stomach or intestines by tumours in the epigastric region. Schroeder van der Kolk described the mental symptoms as being always due to affections of the colon; but disease of other portions of the canal—as the rectum and anus—also produces them.

JOHN SIBBALD.

7. Hereditary Insanity.—SYNON.: Fr. *Folie Héréditaire*; Ger. *Erbliche Geisteskrankheit.*—This implies insanity symptomatic of hereditary weakness of the brain and nervous system, generally coming on without the intervention of appreciable exciting cause.

The nervous system seems to be peculiarly liable to be involved in the effects of hereditary degeneracy, and this is frequently evinced by the occurrence of mental symptoms. The ages at which these are developed, and the character which they exhibit, depend both on the nature and on the strength of the hereditary disposition. The forms of insanity, however, which seem to be most directly the result of hereditary influence, generally make their appearance at those periods of life when either rapid structural development takes place, special functional activity is first exhibited or is ultimately arrested, or upon the advent of senile decay. The ordinary exciting causes of insanity may also affect persons at these periods, and in such cases the resulting disorder will be stamped more or less distinctly with the impress of its origin. But where these forces do not come powerfully into play, it is found that hereditary insanity exhibits a special character according to the period at which it is developed. We have thus an *insanity of pubescence*, a *climacteric insanity*, and a *senile insanity*. Idiocy and imbecility (which will be found discussed under the head of the former) are also frequent results of hereditary weakness, showing itself during fœtal life, or during the period of dentition; and the mental derangements which often affect women at parturition, and during the processes which precede or follow it, seem to occupy a position in the pathological scale intermediate between the hereditary and the accidental forms of insanity.

Insanity of pubescence is a condition not infrequently met with, and one which it is very important to recognise early in its true character. Much unintentional injury is frequently done by the patient being at first regarded as a delinquent and treated accordingly, instead of receiving the careful management suitable to the disease. The affection is characterised by great disorder of the emotional and moral nature, which is evinced by restless though seldom violent excitement, perverted eroticism, acts of purposeless mischief, and exhibitions of inordinate vanity. Any marked change of disposition during the passage from youth to adult life ought to be regarded as probably pathological in its nature, and must be carefully watched. Towards the completion of the period of adolescence there is a special liability to acute maniacal attacks, characterised by excitement of the sexual or religious emotions. The physical condition is indicated by capricious appetite and symptoms of anæmia. The treatment required is rest to the mind, both in its intellectual and emotional energies, with cultivation of everything likely to develop physical vigour. The diet should be abundant, but chiefly milk, eggs, and farinacea. Butcher's meat should be used sparingly, and alcohol prohibited. If the hereditary tendency is not exceptionally strong, the prognosis is not unfavourable.

Climacteric insanity occurs in males between the ages of fifty and sixty, and in females between forty and fifty. Its general character is a form of melancholia, gradual in its development, manifesting itself in loss of sleep, fear of undefined evil, religious despondency, hallucinations of the senses, refusal of food, and frequently in a suicidal tendency. Excitement and exaltation occur rarely, and are generally of short duration. The mental disorder is frequently accompanied by very marked emaciation, and the tendency is always to anæmia. The treatment required at the commencement is cessation of mental labour and change of scene. During the whole progress of the disease the diet should be full and nourishing, and the digestive functions often require to be stimulated to healthy action. In the majority of cases the prognosis is unfavourable, and where recovery does not take place within one or at most two years the course is generally towards dementia.

Senile insanity is essentially a form of dementia, which comes on gradually in persons who have passed through the earlier periods of life without disturbance of their mental health, but who break down in old age. Its principal features are loss of memory, slight excitements, whimsical likings and dislikings, querulousness, and a gradual decadence into fatuity. It is subject to occasional remissions, which are sometimes very short, as when caused by the stimulus of acute febrile states. But these may be so prolonged as to amount practically to recovery. Not infrequently the breakdown of the nervous system pursues a rapid course, and in such cases there is often a marked similarity in the symptoms to those of general paralysis. Both mental and physical conditions in the advanced stages of each are sometimes practically indistinguishable. The diagnosis will depend on whether the characteristic first stage of general paralysis has been observed at the commencement, or only a gradual loss of physical and mental power. Paralytics, moreover, are seldom of advanced age.

John Sibbald.

8. Impulsive Insanity.—Violent acts are committed under an insane impulse by many patients whose insanity is plain and acknowledged. They may be done under the influence of delusions or hallucinations, but the term *impulsive insanity* is commonly applied to a disorder manifested, not by delusions and similar symptoms, but by acts of violence to which a patient is driven by blind, uncontrollable, and morbid impulse, whereby the will and the reason are overpowered for a longer or shorter time. These are for the most part acts of *suicide* or *homicide*; and in connexion with the latter, great controversy has arisen as to the responsibility of persons committing them. Here, as in moral insanity, there are no delusions; frequently no change will have been detected in the individual prior to the act, nor will there be observers of it. And it is a fact that the impulse may be satisfied and exploded in the act, and having thus found a vent may be felt no longer, at any rate for a time. It may be as sudden as an epileptic fit, and may, like the latter, bring relief to the brain. Indeed, there is a strong connexion as well as analogy between the two disorders, and, as Dr. Maudsley says, instead of a convulsive movement there is a convulsive idea.

In estimating such acts as these we must not only consider the act itself and the manner of its performance, but must also closely inquire into the past history of the perpetrator and his progenitors. For all this we may or may not have opportunity. If the act is one of attempted suicide, and the individual is kept under observation, we may have no difficulty in diagnosing insanity. If it is one of homicide, and the criminal is in prison for, perhaps, only a week or two, opportunity of ascertaining the history of his family may fail, nor will he himself be under skilled observation. Moreover, the period just after the committal of an impulsive homicide will very probably be the one in which fewest symptoms of insanity will be noticeable. The period immediately preceding it will be that which most closely demands a scrutiny, but we may not be able to get any information if the accused has been moving from place to place, has been among strangers, or has had those about him who were obtuse and unobservant. Many acts of suicide and homicide would be prevented if the friends did not shut their eyes with pertinacity to the strange and altered looks and conduct of the patient. But in this impulsive form, although there may not have been enough to warn those about a man to restrain him, there may have been symptoms which are sufficient subsequently to indicate to a physician the presence of mental disorder. There may have been attacks of *grand mal* or *petit mal*; there may have been former attacks of insanity, periods of, perhaps, slight depression, which, though they attracted little notice at the time, may indicate an insane diathesis. The sufferer may have been sleeping badly or have taken less nourishment than usual.

The medical witness will, in the case of homicide, carefully examine and pay special attention to the following points :—

(*a*) The nature and character of the act must be noted. The presence or absence of motive may often assist us. When the victim is near of kin and dearly loved, suspicion of insanity will at once arise. When, on the other hand, it is a perfect stranger, never before seen, where there has been no previous meeting or quarrel, the same suspicion will arise. The method of the act may guide us somewhat, but not so much. There may be premeditation, though generally there is not.

(*b*) The demeanour of the prisoner after the act may assist us. Were there, or were there not, attempts to conceal it, or to escape detection and arrest, and, if so, what was the nature of them? What was said in explanation? It sometimes happens that there is complete unconsciousness or forgetfulness of what has occurred, and we may then strongly suspect the presence of epilepsy.

(*c*) We must closely inquire into the family history, and shall often find that, in cases of impulsive homicide, the family of the accused has suffered with insanity. And where this is so, we may also find that from youth the accused has been deficient and weak in intellect, or odd and eccentric. The weak-minded, in fact, may be grouped in a special class of homicides. As there is a weak-minded moral insanity, so there is a weak-minded impulsive homicidal insanity, the sufferers from which have not infrequently been hanged, their insanity not having been sufficiently marked to absolve them from legal responsibility. Fits in childhood may contribute to this state. And throughout, at the age of puberty, or in adult life, there may be slight but sure indications of the insanity that has been inherited, which are displayed in an impulse to mischief, homicide, or suicide, even as in others the tendency is shown in ordinary attacks of insanity.

(*d*) We must look very closely for symptoms or a history of epilepsy. Such indications as nocturnal micturition or a bitten tongue may guide us to the truth; while in acknowledged epileptics it may happen that the homicidal attack takes the place of the ordinary convulsion, and without the occurrence of the latter there may be a period of unconsciousness and unconscious action lasting, perhaps, for days. *See* EPILEPTIC INSANITY.

The occurrence of one homicidal attack of a strange or anomalous character may make us fear its recurrence; and when we have to examine a criminal who has committed one act of this kind, it is important to inquire whether he has ever at any former time done any sudden act of violence of a similar description. For this reason such patients should not be released from an asylum, except under great and special precautions.

G. F. BLANDFORD.

9. **Legal Insanity.**—Lawyers regard insanity from a different point of view from medical men. A medical man applies his mind to its study so as to ascertain how far he may infer from the evidences of mental action the existence of morbid conditions which he may hope to alleviate or remove. It is therefore his duty to be acquainted with such symptoms as give the earliest indication of the approach or development of these morbid processes. For it is during their initiatory stages that he may most successfully intervene with the resources of his art, to check their progress or to ward them off. He therefore identifies with the existence of disease every deviation from the healthy mental standard which indicates the necessity for medical treatment or advice. A lawyer, on the other hand, takes note of insanity only in so far as it affects the safety of person or the preservation of property. The question which he seeks to determine is whether a person is justly responsible for certain acts which he has committed, or is competent to perform certain acts which he may be called on to perform. It is evident, therefore, that the legal view of insanity must naturally be much more limited than the medical. 'A lawyer, when speaking of insanity,' says Sir James Stephen, 'means conduct of a certain character; a physician means a certain disease, one of the effects of which is to produce such conduct;' and though this has been adversely criticised, it seems to show correctly the directions in which the two views diverge. They might perhaps be as fairly indicated in other words if we say that the lawyer has to deal with the nature or quality of certain acts, while the physician has to deal with the condition of certain persons. No satisfactory general definition of legal insanity has been given. In the earlier ages of our legal system none but the most outrageous cases of insanity were recognised. Bracton in the thirteenth century defined a madman as 'one who does not understand what he is doing, and, wanting mind and reason, differs little from brutes.' Sir Edward Coke, though he recognises different classes, according as the insanity is congenital, permanent, or temporary, only admits that a person is insane when he is *non compos mentis*, or has wholly lost his memory and understanding. Sir Matthew Hale, in the seventeenth century, was the first to recognise the existence of less extreme forms of insanity. 'Some persons,' he said, 'that have a competent use of reason in respect of some subjects, are yet under a *particular dementia* in respect of some particular discourses, subjects, or applications; or else it is partial in respect of degrees, and does not excuse persons who commit capital acts in this state.' He also said that it is 'very difficult to define the invisible line that

divides perfect and partial insanity,' and 'that most persons that are felons of themselves or others, are under a degree of partial insanity when they commit these offences.' The recognition of these gradations, reaching even to the mutual overlapping of crime and insanity, indicates as much breadth of view as could be expected at a time when the very judge who recognised them passed sentence of death on persons convicted of witchcraft. We cannot doubt, indeed, that at that period the ignorance of the nature of insanity was such that many lunatics were executed for this offence. The recognition of the necessity of taking legal account of degrees of insanity less severe than 'furious madness' or idiocy may be said to have commenced at the beginning of the present century. The mode in which unsoundness of mind comes into relation with law at present may be looked at most conveniently from three points of view: 1. Where a person suffers from such unsoundness of mind that it is necessary for his welfare, or the safety of the public, that his liberty should be restricted, by his being placed in an asylum or subjected to similar restraint. 2. Where a person suffers from such unsoundness of mind that he is incapable of managing himself or his affairs. 3. Where irresponsibility for crime, on account of insanity, is pleaded in a court of law. It will be found more convenient to consider these three relations of insanity and jurisprudence separately. *See* LUNACY, Law of; CIVIL INCAPACITY; and CRIME, Irresponsibility for.

JOHN SIBBALD.

10. Moral Insanity.—SYNON.: Fr. *Manie sans Délire*; *Folie Raisonnante*; *Monomanie Affective*; Ger. *Gemüthswahnsinn.*

Under the names of *moral insanity*, *emotional insanity*, *impulsive insanity*, *affective insanity*, has been described the disorder of certain patients, which is manifested by insane actions and conduct rather than by insane ideas, delusions, or hallucinations. Such persons are sometimes said to be of whole and perfect intellect, though unsound in the moral and emotional part of their brain. They come under the notice of medical men not so much for purposes of treatment as for diagnosis. Their conduct being chiefly displayed in foolish or violent acts, they require to be restrained, and the question arises: Is this conduct badness or madness? are they responsible for it or not?

Dr. Maudsley gives *moral insanity* and *impulsive insanity* as two subdivisions of *emotional* or *affective insanity*; and, as the symptoms are certainly different, we cannot do better than consider them under separate heads. But certain observations are applicable to both. In neither will there be found delusions; and as delusions are, in the opinion of some, especially lawyers, necessary to the establishment of legal insanity and irresponsibility, these patients, according to them, are not legally insane. Another remark is that this moral or impulsive insanity does not constitute a definite and well-marked disease, like acute delirium or general paralysis. Every patient may at one time or other be 'morally insane'—that is, may not have reached the stage of delusions, or may have recovered from it, and every patient may commit 'impulsive' acts of violence, whether his insanity is displayed in other ways or not.

By *moral insanity* is to be understood a disorder of mind shown by an entire change of character and habits; by extraordinary acts and conduct; extravagance or parsimony; false assertions and false views concerning those nearest and dearest, but without absolute delusion. Such a change may be noticed following any of the ordinary causes of insanity. It may follow epileptic or apoplectic seizures, or may be seen after a period of drinking. Its approach is gradual, as a rule, rather than sudden, and the extraordinary character of the acts may not at first be so marked as subsequently. Friends wonder that a man should say this or that, or should do things so foreign to his nature and habits, but some time may elapse before they can convince themselves that such conduct is the result of disease, and the acts may be such that many will look upon them even to the last as signs merely of depravity. Such insanity, of course, varies in degree. When it is well marked, and the conduct is outrageous, there will be no difficulty in the diagnosis. But it may be less marked; it may consist of false and malevolent assertions concerning people, even the nearest; of little plots and traps to annoy others, in which great ingenuity and cunning may be displayed. And there will be the greatest plausibility in the story by which all such acts and all other acts will be explained away and excused. It would seem sometimes as if a universal badness had taken possession of the individual, yet a badness so inexplicable that it can only be looked upon as madness. Where we can ascertain that this condition of things is something which has come over the patient, being formerly absent, and that he is altogether changed, we may suspect insanity. But much examination and opportunity for examination may be needful before we can sign a certificate, for such people are often very acute, and quite on the alert. They have no scruples about falsehood, and will deny or justify everything with which they are taxed; and where the insanity is manifested in conduct, the medical man may never be a witness of it, and is obliged to receive on hearsay that which the patient strenuously denies. Careful inquiry, however, will probably reveal the origin and cause of the change. There may have been a period, though short, of acute insanity—as acute mania or melancholia—which passed away and left this as a permanent condition; or it may be the precursor of a more advanced stage of the disorder, one marked by the ordinary symptoms, as delusions and hallucinations. If the change has been rapid and progressive, if the sufferer has become more and more outrageous and eccentric, it is likely that in a short time unmistakable insanity will be displayed; but some cases progress slowly, and steps for restraint have to be taken before anything like delusion is to be found. It may be necessary to prevent a man from squandering all his property—a common symptom in this variety—or from wandering from home and absenting himself no one knows where, or keeping low company. And when a man previously quite sober suddenly takes to drinking, the question may arise whether this is not the effect of insanity. Great difficulty may be found in proving the latter, but unquestionably it is often the case. Here, however, if the habit is indulged in, the patient will most likely get rapidly worse, and then restraint will be more easily enforced.

Moral insanity may be the precursor of general paralysis; it may also be the sequel and result of a more severe insanity; it may be the outcome of apoplexy, or of a blow or other damage to the brain. It may be one of the alternating states of the so-called *folie circulaire*. Here a period of depression alternates with one of excitement, gaiety, self-glorification, or irascibility, and the latter may be one closely resembling that usually called moral insanity, and evidenced by exaggerated conduct and absurd acts. It may follow a simple attack of epilepsy, or may be the precursor of such attacks, being a part of that epileptic condition known as masked epilepsy. *See* EPILEPTIC INSANITY.

The one constant and marked feature of this insanity is the absence of delusion; but we are not on this account to argue that the intellect is sound. There is often great acuteness and cunning displayed by such patients, yet along with the cunning there may be the most silly and foolish conduct. Often there is great acuteness shown by those who have delusions, but because of the latter we say their intellect is disordered. Yet it is proof of disorder of the intellect if a patient spends his capital as though it were income, defends and justifies the most outrageous acts, and cannot be made to see that they are outrageous. Close examination will probably reveal the fact that there is very considerable intellectual lesion in these cases. There is a want of the power of attention and concentration of ideas on a subject. A patient commences a story of his grievances, and in two minutes is far away from his theme, and is boasting of his virtues or conduct, and no amount of bringing back will enable him to give a definite and succinct account of what he has to complain of. Such rambling is a marked symptom of this insanity, and a strong indication of a weakened intellect.

There is one more form of moral insanity which is, perhaps, the hardest of all to diagnose and estimate. It is the congenital moral defect occasionally met with in persons who have been from birth odd and peculiar, and incapable of acting and behaving like other people. They can hardly be called idiots or imbeciles, for they may exhibit a considerable amount of intellect and even genius in certain special directions. We shall generally find that they are the offspring of parents strongly tainted with insanity, epilepsy, or alcoholism, and many in childhood are the subject of fits, chorea, or other neuroses. They are incapable of being instructed like other boys and girls; are often frightfully cruel towards animals, or their brothers and sisters; and seem utterly incapable of telling the truth or understanding why they should do so. Here there is no change; we cannot compare the individual's condition with a former one, but we can only estimate him by the average of mankind. These are the persons who commit crimes and become the chronic inmates of prisons, and it is most difficult both for medical and other prison-officials to say how far they are responsible, and how far not. Careful and special education is needful for them, and this they may obtain if they are born of well-to-do parents; but a vast number are to be found amongst the ranks of the lower classes; the offspring of intemperance and poverty, they swell the numbers of the criminal classes in no inconsiderable degree.

G. F. BLANDFORD.

11. Pellagrous Insanity.—This is a form of insanity associated with pellagra, and not met with in Britain. It is characterised by mental symptoms usually indicative of anæmia—great depression, frequently with tendency to suicide, passing on to chronic dementia. It is most frequently met with in some parts of Italy.

12. Phthisical Insanity.—It has been generally observed that there is a special mental character associated with pulmonary tuberculosis. This consists frequently in a peculiar cheerful hopefulness, which has received the name of *spes phthisica*, and which seems strangely out of harmony with the unmistakable signs of an inevitable fate by which it is accompanied. But there is also a state of mental depression which has been observed in intimate association with the disease. The peculiar hopefulness is most frequently met with in the acute and active forms of phthisis, and it is often so irrational and persistent as to amount to an insane delusion, growing as it does in strength while the evidences of its baselessness accumulate. In the last stages of the malady the religious and general emotional exaltation is often extreme, and actual delirium sometimes occurs. An opposite mental condition may be met with in chronic phthisis, more especially in that form of it which has been called latent. Throughout the course of the disease there is then a prevailing depression and distrustfulness, though the physical symptoms are neither so distressing nor so obvious as in the acuter forms. The mental symptoms sometimes precede the physical. Languor and depression, mingled with waywardness, are characteristic of the initial stage. This is usually accompanied by general functional debility, which is often attributed to mere disturbance of digestion and nutrition. The skin is habitually pale, and the circulation feeble. In many cases the physical signs of pulmonary disease when present are apt to be overlooked, and occasionally they escape observation for years. Where the mind is much affected, the ordinary symptomatic cough, expectoration, and dyspnœa are often absent; and this is the case sometimes where physical exploration reveals the existence of extensive vomicæ and other characteristics of advanced disease. As the further stages are reached the mental condition becomes less one of depression and more one of distinct enfeeblement. Occasional fits of considerable irritability and great excitement occur. Dr. Clouston, who first drew special attention to this condition, says of the patients that 'there is a want of fixity in their mental condition. There is a disinclination to enter into any kind of amusement or continuous work; and if this is overcome, there is no interest manifested in the employment. It might be called a mixture of subacute mania and dementia, being sometimes the one and sometimes the other. As the case advances, the symptoms of dementia come to predominate; but it is seldom of that kind in which the mental faculties are entirely obscured, with no gleam of intelligence or any tendency to excitement. If there is any tendency to periodicity in the symptoms at all, the remissions are not so regular, nor so complete, nor so long as in ordinary periodical insanity. If there is depression, it is accompanied with irritability and the want of any fixed depressing idea or delusion. If there is any single tendency that characterises these cases, it is to be suspicious.' Where any chronic form of insanity is associated with phthisis, the chance of complete restoration to sanity is very small.

In the affection distinguished by emotional exaltation no special treatment is called for. The only indication of treatment in the other type of disease is the necessity of keeping up a full supply of nourishment to the brain, by the use of nutrient enemata or otherwise. Where the mental condition is much disturbed, a trustworthy attendant ought to be employed, and the general treatment should always be tonic and stimulating. Removal to an asylum ought in most cases to be avoided. John Sibbald.

13. Puerperal Insanity.—Synon.: *Insania Gravidarum*; *Insania Puerperarum*; *Insania Lactantium*; Fr. *Folie Puerpérale*; Ger. *Puerperalmanie*.

Definition.—Insanity developed during pregnancy, parturition, or lactation.

It has been the custom of authors, till a recent period, to include under this heading the forms of insanity which occur in females during the periods of utero-gestation, the puerperal state, and lactation. It is now frequent to find the term 'puerperal' restricted to the derangements which come on at the time of delivery, or within a short period thereafter. Whatever names we adopt, it is impossible to consider the insanity occurring at these different periods quite independently. The condition of the woman during the whole process, from the time of conception till the child is weaned, represents one of those physiological crises during which congenital or acquired weakness of constitution tends to show itself.

The *insanity of pregnancy* generally takes the melancholic, though sometimes the maniacal form, and seems to be due to an incapacity in women of neurotic tendency to bear the special strain of the reproductive process. The delusions which characterise the disorder are generally exaggerations of the anxieties and whims so frequent in pregnancy. The family affections are weakened or perverted. In the severer forms the suicidal impulse is strongly developed. Mental disorder seldom commences before the third month of pregnancy, and most frequently about the sixth month. Except in the severer forms the prognosis is generally favourable; but recovery seldom occurs till the termination of the gestation. Asylum treatment should be avoided when the circumstances of the patient permit of suitable nurses or companions being employed at home.

Puerperal insanity in its more restricted meaning is frequently understood to include all derangements occurring at parturition, or within six or eight weeks after it. But it is better to limit the term to what occurs during the first three weeks, as the form of disorder which commences after that period is generally different in character.

Ætiology.—Prominent among the causes of puerperal mania are all states of debility, either induced before parturition by want, intemperance, disorders of nutrition, or rapid succession of pregnancies, especially if lactations and pregnancies are carried on simultaneously; or it may be the result of weakness induced during parturition by hæmorrhage or exhaustion. It is liable to occur in primiparæ, when the subjects are either exceptionally young or exceptionally advanced in life. Irritation arising in the pelvic organs, intestines, or mammæ also tends to produce it. Any inordinate mental excitement or depression is apt to bring it on. In a large number of cases it will be found that there is a hereditary neurotic tendency.

Symptoms.—Attacks of maniacal excitement sometimes occur during actual parturition. They are usually of very short duration, and seem to be directly dependent on the intense suffering which may accompany the pains. The most frequent period of their occurrence is when the head of the child is passing either the *os internum* or the *os externum*. The more serious phase of the disorder is in its acute stage a variety of acute maniacal delirium. It usually commences within a week or ten days after delivery. Generally it is preceded by sleeplessness, and the patient manifests more or less apprehension of coming evil. Sometimes, however, she awakes delirious from what had been regarded as a healthy slumber. When the attack has commenced, sleep is always either very imperfectly obtained, or is altogether absent. The pulse is thready and quick; the skin often, but not always, dry and hot; and the head throbbing. The eyes are bright, and the face generally pale, with occasional flushing. The expression is usually indicative of alarm or suspicion on the part of the patient. The tongue is dry and furred, and the secretions of milk and lochia are either suppressed or diminished. The bowels are sometimes loose, but constipation is the usual condition. The appetite is uncertain; sometimes it is abnormally large. Not infrequently the sense of taste is perverted, and the patient suspects the presence of poison in her food, and persistently refuses it. The breath is often offensive in odour. Sometimes the mental excitement does not reveal itself in language, and the patient may be obstinately taciturn from the commencement. But there is usually a great increase of loquacity, gradually progressing from the beginning, and passing into incoherent raving. Sudden impulsive acts of violence frequently manifest themselves in this disorder, and in these the patient often attempts to destroy herself, her child, or persons for whom she has usually the most affectionate regard. She generally appears to be dissatisfied with those in attendance on her, and often entertains delusions as to their identity. In many cases the mental condition bears a strong resemblance to that of delirium tremens, especially when the patient has undergone privations, or has been intemperate during pregnancy.

Diagnosis.—The only conditions for which puerperal insanity may be mistaken are the typhoid delirium of puerperal fever or pyæmia; and the violent excitement frequently symptomatic of meningitis. In these cases the febrile condition precedes the development of the delirium, while in puerperal mania the mental symptoms show themselves from the first. In meningitis the pupils are generally contracted, and the headache is peculiarly intense; while in puerperal mania the pupils are usually dilated, and the headache is not a very prominent symptom.

Prognosis.—According to the published statistics of this disease, recovery may be expected in about 70 per cent. of the cases, and a fatal termination need not be anticipated in more than 5 per cent. But as these figures are in a great measure obtained from asylum statistics, and other sources in which only the severer and more persistent forms have been taken into account, it may be fairly assumed that the true estimate would be much more favourable. The duration of the insanity may vary from a few days to a year, after which time the proportion of recoveries becomes extremely small. The great proportion of recoveries takes place during the first six months. The most favourable symptoms, in addition to amelioration of the mental symptoms, are increase of bodily weight, and restoration of the catamenia.

Treatment.—The transitory mania which sometimes accompanies the severer pains of labour does not require special treatment; but anæsthetics may be given as a preventive measure in cases where there is a known liability to such excitement. Special care ought also to be taken after such attacks to avoid injury by premature bodily exertion, unnecessary social intercourse, disquieting news, or any kind of mental or moral strain. In the treatment of the graver form of puerperal mania, the chief objects are to remove all sources of irritation, to restore the patient's strength, and to obtain repose. If there is any accumulation of fæces, a smart purgative should be at once administered. If the lochial discharge is scanty, an injection of warm water, containing carbolic acid or some other antiseptic remedy, should be given *per vaginam*. The condition of the bladder should be ascertained, and this organ should be relieved, if necessary; care should also be taken not to allow the breasts to be over-distended. In every case the patient should from the first receive as much light and nourishing food as her digestive powers can bear. Where food is refused, custard must be given largely and frequently. Nutrient enemata or suppositories should be administered, or even the œsophagus tube used if necessary. In those cases in which violent excitement does not come on suddenly, an attack may sometimes be warded off or cut short by relieving the sleeplessness which is one of the early symptoms. A full supply of easily digested nourishment is often the best hypnotic. Chloral hydrate, or perhaps sulphonal, will be useful. Opium ought to be avoided, and hyoscyamus and belladonna cannot be relied on. Both in the first stage, and when the disease is more advanced, everything must be done to promote tranquillity. The room should be darkened, and stillness maintained as far as possible, for the attention of the patient is very easily excited, and both vision and hearing are preternaturally acute. Constant supervision is necessary, however, on account of the tendency to sudden impulsive violence; and the patient should see her infant as seldom as possible. After the maniacal condition has fairly declared itself, the child should be removed altogether, as its presence is sometimes productive of great excitement in the patient, and must always be regarded as attended with risk. In cases where the excitement is somewhat of a hysterical character, bromide of potassium, given in twenty-grain doses at intervals of four hours, may produce good results. Cooling applications to the head sometimes soothe irritation, and induce sleep. Digitalis in small doses, and warm baths, have proved useful. Alcoholic stimulants should generally be given with the food; their effects being carefully watched, and the quantity varied accordingly. Bleeding and every kind of depletion should be avoided. The nursing and attendance should, if possible, be entirely entrusted to strangers, and the patient should not be permitted to see any members of her family. It will sometimes be necessary, especially in the case of poor persons, to resort to asylum treatment; but this ought not to be done if it can be avoided, and with patients in good circumstances it ought never to be necessary in the acute stage of the disease. When the disease becomes chronic, tonics, such as quinine and iron, ought to be given; and a plentiful supply of judicious nourishment should then, as all through the illness, be carefully administered. Patients liable to this disorder should not be allowed without consideration to nurse their children.

The *insanity of lactation* is symptomatic of causes which come into play after the puerperal period, and it ought perhaps to be looked on as symptomatic merely of prolonged anæmia. Acute maniacal symptoms of short duration may occur; but the characteristic condition is melancholia, ushered in by headache, tinnitus aurium, flashes of light before the eyes, and other signs of debility. A suicidal tendency sometimes appears. The treatment required is to wean the child, and generally to save and increase the strength of the patient. The prognosis is favourable in the majority of cases.

John Sibbald.

14. **Syphilitic Insanity.**—Among the results of constitutional syphilis, affections of the nervous system are not uncommon; and when the disease affects the brain, the mental symptoms that arise are found in the majority of cases to present a marked similarity in their character. In such cases the mental disorder is generally preceded, as in so many forms of insanity, by distressing sleeplessness. This is followed gradually by increasing depression of mind. Religious anxiety of a peculiarly hopeless character frequently shows itself. Exaggerated self-accusings are earnestly uttered by those who have previously been unusually callous as to the results of their actions. Hypochondriacal delusions are not uncommon, and are frequently associated, in the mind of the patient, with the fact of the syphilitic infection. The feeling of alarm which accompanies these symptoms sometimes develops into a violent excitement, which may be called maniacal. If the symptoms be associated with any of the ordinary signs of syphilitic poisoning—the dry, scaly skin, sore-throat, and the sallow lean face; and especially if any of the characteristic eruptions are present, the mental disease may be expected to yield to treatment by mercurials and iodide of potassium. The mental symptoms which have been here described seem to occur without the existence of any important structural lesions in the encephalon. The development of gummy products within the cranium is frequently evinced by symptoms similar to those of general paralysis. Headache of very persistent character, giddiness, vertigo, and epileptoid fits occur, accompanied at first with mental depression. During the progress of the disease attacks of acute delirium are not unusual. Sometimes extravagant delusions, such as are frequent in general paralysis, are exhibited; but generally the progress of the disease is characterised by a gradual falling into dementia. The prognosis in such cases must be regarded as unfavourable, but considerable improvement frequently follows the administration of antisyphilitic remedies.

John Sibbald.

INSECT PARASITES.—Insect parasites are of two kinds, external and internal. The former are described under several affections of the skin (*see* Pediculus); the latter may be classed with the entozoa. *See* Entozoa; Chigoe; and Œstrus.

INSENSIBILITY (*in*, not; and *sentio*, I perceive).—This word signifies either loss of consciousness, or merely loss of sensation in a particular part of the body. *See* Consciousness, Disorders of; and Sensation, Disorders of.

INSOLATIO (*in*, in; and *sol*, the sun). A synonym for sunstroke (*see* Sunstroke). Insolation is also used to designate a method of treatment, which consists in exposing the patient to the rays of the sun.

INSOMNIA (*in*, not; and *somnus*, sleep).—Want of sleep, or sleeplessness. *See* SLEEP, Disorders of.

INSPECTION (*inspicio*, I look upon). The technical name for the examination of a patient by the sense of sight; also for examination of a body *post mortem*. *See* PHYSICAL EXAMINATION; and NECROPSY.

INSTILLATION (*in*, into; and *stilla*, a drop).—The method of applying remedies to a part in the form of drops. Instillation is chiefly employed in connexion with the eye.

INSUFFICIENCY (*in*, not; and *sufficio*, I am sufficient).—A synonym for incompetence. *See* INCOMPETENCE.

INSUFFLATION (*in*, into; and *sufflo*, I blow).—This term is used in the same sense as inflation (*see* INFLATION). It is also a name given to a method of applying remedies in the form of powder to the throat and respiratory passages, by blowing them through a tube into these parts. *See* INHALATIONS, Therapeutic Uses of.

INTEGUMENTS, Diseases of.—*See* SKIN, Diseases of.

INTELLECTUAL INSANITY.—*See* INSANITY.

INTEMPERANCE, Effects of.—*See* ALCOHOLISM; and DISEASE, Causes of.

INTERCOSTAL NEURALGIA.—Any of the dorsal nerves may be the seat of neuralgia, not differing materially in its symptoms from neuralgia affecting other mixed nerves, but especially important from a diagnostic point of view. The pains are paroxysmal; usually affect the region of distribution of the anterior division of one or two of the dorsal nerves; and are confined to one side, most frequently the left.

ÆTIOLOGY.—The female sex, neurotic heritage, and weak general health predispose to intercostal neuralgia. As determining causes may be mentioned blows; the action of cold; local injury to the nerves from the growth of thoracic aneurysm or tumour; and disease of the vertebræ. Exhaustion from over-suckling, menorrhagia, or leucorrhœa; irritation from cracked nipples; and pregnancy, are all occasional but important causes of this form of neuralgia. The pain met with in the chest in early cases of phthisis is not infrequently due to intercostal neuralgia. It is probable that, in a large proportion of cases, the neuralgic pain is due to neuritis of one or more intercostal nerves.

SYMPTOMS.—Pain is complained of at some part of one side of the thorax or abdomen, most often in the region innervated by the sixth, seventh, eighth, or ninth intercostal nerves, and much more frequently in the front or side than behind. It is occasionally found in the axilla and inner side of the arm. The pain may be intermittent, occurring in paroxysms, varying in number from a recurrence every few minutes to only two or three such during the twenty-four hours; or there may be persistent pain of a dull character, interrupted at varying intervals by darts of a very sharp kind, which may sometimes be referred with precision to the course of the neighbouring nerve. The pain is described as 'tearing,' or resembling such injuries as a 'stab of a knife,' or 'boring with a red-hot iron.' The acts of coughing or sneezing, as well as any rapid movements of the body, are apt to increase the distress, but the pain is also independent of these disturbances, and will attack without any such provocation. The pain is sometimes more of a wearing than acute character, and the rest will often be destroyed by it. Painful points are sometimes to be discovered in the following situations: 1. Over a spinous process corresponding to the emergence of the affected dorsal nerve from the intervertebral foramen. 2. At the side of the chest or abdomen, where the lateral branch becomes subcutaneous. 3. Near the sternum or at the margin of the rectus abdominalis muscle, at any part down to the pubes, where the termination of the nerve supplies the skin. The skin in the neighbourhood of the tender points is sometimes so hyperæsthetic that the pressure of the clothes is painful. In epileptics and other highly neurotic patients, intercostal neuralgia is often associated with palpitation of the heart, and the pain is usually referred in a vague manner to that organ. Close examination will show that it is in the chest-wall, and tender points may generally be discovered. The affection is not accompanied by fever. The paroxysms of pain may produce fainting and vomiting. They often cause dyspnœa, with an anxious expression of face, from the inability to draw a full breath without starting the pain.

COMPLICATIONS.—Intercostal neuralgia is sometimes accompanied by herpes zoster. The pain usually precedes the appearance of the eruption, but it is occasionally coincident only, and sometimes comes after it; more often than not it outlasts the eruption, possibly for a long period. In certain cases actual pain lasts but a few days, but is succeeded by an intolerable itching, which is described as being under, not in, the skin. This sensation is said to be felt less in walking than when at rest.

Not infrequently neuralgia of some other nerves, either at a distance, as the fifth, or anatomically near, as the brachial plexus, occurs as a complication of intercostal neuralgia. This is especially likely in cases happening in the period of bodily decay. It is then, too, that the affection may occasionally be accompanied by attacks of angina pectoris.

Diagnosis.—Absence of pyrexia, as shown by the use of the thermometer; the intermittence of pain, and its occurrence irrespective of respiratory movements, although liable to be precipitated by them; and the results of physical examination, serve to distinguish intercostal neuralgia from pleurisy, a condition with which it is very apt to be confounded, on account of resemblance in the stabbing character of the pain. It should be remembered, however, that exceptionally no rise in temperature may accompany the painful stage of pleurisy.

From muscular rheumatism it may be discriminated by the presence of the small and characteristic tender points; by tenderness of the spinous processes on pressure; and by the pain being found to be not dependent upon movements. The same features serve to distinguish it from myalgia, especially that form which often comes from long-continued use in an unaccustomed manner of some muscle attached to the ribs, as when a person unused to carpentering handles the saw energetically for a long time.

Physical examination and the presence of pyrexia will preserve from the error of confounding the dull pain often noted in pneumonia with that of intercostal neuralgia.

Pains of a stabbing, plunging, or electric-shock-like character are often experienced in the intercostal spaces in the course of tabes, and it is important not to confound this disease with a simple attack of intercostal neuralgia. The distinguishing points are the occurrence of similar pains coincidently or alternately in other parts of the body, especially in the lower extremities; the absence of patellar tendon reflex; and the characteristic gait (if present)—all which mark tabes. *See* Tabes Dorsalis.

Prognosis.—As in the case of other forms of neuralgia, that of the intercostal nerve can hardly be said to be attended with danger, though it must be allowed that in some very rare instances the severity of the pain appears to have actually destroyed life. It is apt, however, to be of troublesome duration, dependent on the cause, lasting for periods of weeks or months, and liable to recurrence.

Treatment.—Search should be made in other branches of the same nerve, and in the distribution of neighbouring nerves, for any source of irritation which it is possible to remove. Constipation of the bowels should be treated by three grains of blue pill, followed by some Friedrichshall or Hunyadi Jånos water, repeated on two or three occasions. Quinine should be given in doses of from five to ten grains twice a day; and if there should be a state of anæmia, iron should be added. Phenazone in doses of from ten to twenty grains may be given two or three times a day, if necessary. Exposure to cold and damp must be avoided; whilst the surroundings generally should be favourable to improving the nutrition and tone. If the pain be very acute, and sleep prevented, morphine may be injected hypodermically in the neighbourhood of the affected nerve, commencing with a dose of a twelfth of a grain, and increasing this, if necessary, to a quarter of a grain in the twenty-four hours. This dose should not be repeated, however; and it is better to be satisfied with a repetition of the smaller dose, if required. Small blisters (size of half-a-crown) may be applied to the neighbourhood of the spinal column, near the point of emergence of the affected nerve, one succeeding another as it heals. The continuous voltaic current, from about ten to twenty cells, Leclanché or Stöhrer, may be applied, one sponge on the spine and the other upon the painful points in turn. There is no better application than flexible or anodyne collodion for the herpes zoster which sometimes complicates intercostal neuralgia. *See* Neuralgia.

T. Buzzard.

INTERLOBULAR (*inter*, between; and *lobulus*, a little lobe).—Situated in the tissue between the lobules of any organ. A good illustration is *interlobular emphysema*, in which air occupies the tissues between the lobules of the lungs.

INTERMITTENT (*intermitto*, I leave off for a time).—A temporary cessation or suspension, either of a function, for example, of the action of the heart, when the pulse is said to intermit; or of a disease, such as neuralgia or ague, when the symptoms cease for a certain time. *See* Pulse; and Intermittent Fever.

INTERMITTENT FEVER.—Synon.: Ague; Fr. *Fièvre Intermittente*; Ger. *Kaltes Fieber*.

Definition.—A fever of malarial origin, characterised by the sudden rise of temperature during the paroxysm; by the equally sudden fall at its termination; and by the regularity of the times of accession and apyrexia.

Ætiology.—Intermittent fever belongs to the class of malarial or paroxysmal fevers. It is the most typical, and the most common of the class. The human system once subjected to the phenomena of a regular attack of ague in any of its forms, may be for the remainder of the life of the person so affected liable to a repetition of the attack, without his necessarily having been exposed afresh to the action of its cause. This tendency is very commonly shown in those who, after long residence in hot and malarial climates, are exposed to the influence of cold, and especially easterly winds, on their return to temperate climates in the springtime of the year. The more the person has suffered from the blood-changes and visceral degenerations described in the article Malaria, the more prone is he to such recurring attacks. Malarial fevers differ from most others in an important particular: they are not communicable from person to person.

Anatomical Characters.—In the article Malaria the pathology of intermittent fever is fully discussed, including the question of its parasitic origin. The spleen is enlarged; and in pernicious agues proving rapidly fatal, it is found greatly softened—often reduced to a state of deeply pigmented pulp. Death is common in malarious countries from rupture of the spleen, the result of blows or kicks, often of no great severity. The liver is usually somewhat congested and pigmented, and in cases of long standing it enlarges like the spleen, with the same increase in the connective tissue. In the algide cases hereafter described, when blood is driven in large quantity into the abdominal viscera, the digestive mucous membrane of the stomach and duodenum is congested and softened. The heart is invariably soft and flaccid, pale, sometimes of a dirty yellowish colour—degenerative changes induced by the combined action of diseased blood and high temperature.

Blood-changes.—Blood-changes of a remarkable kind are invariably present in all malarial fevers (*see* Malaria), and often occur with astonishing rapidity. Army medical officers serving in the Mauritius during the epidemics of malarial fever which prevailed there some years ago, noted that the sufferers were often reduced to a state of complete anæmia in a few hours; the same is the case in Algeria. In such cases dropsical affections supervene, often rapidly, and military medical officers there record cases 'proving suddenly fatal from œdema of the glottis.' The blood is changed before any of the usual symptoms of an attack are present —it becomes dark in colour; the serum which separates has a dark-brown colour; and, when exposed to the air, the coagulum, which is large and loose, does not assume its usual bright-red colour. The white corpuscles are greatly increased in number; and the red corpuscles do not evince their usual tendency to run together in rouleaux.

State of the urine.—The urine contains a large amount of free acid, and retains a highly acid reaction for many days in the hottest weather. In the intervals it is often alkaline. When the paroxysms cease, the watery part of the urine diminishes; and it assumes a deep orange colour, depositing also an abundant sediment of urate of ammonium. This change is often observed by intelligent patients, who learn to appreciate its favourable significance. The late Dr. Parkes has shown that at the first elevation of temperature the urea increases; this lasts during the cold and hot stages; then it decreases, falling below the healthy average. Colin and other French authors note the enormous excretion of urea in malarial fevers both in Italy and Algeria.

Varieties and Symptoms.—Three forms of ague have long been recognised—namely, the *quotidian*, which recurs in twenty-four hours; the *tertian*, in forty-eight hours; and the *quartan*, in seventy hours. The term *double tertian* is used when the paroxysm recurs regularly on alternate days, the attacks being alike in severity and duration. Other more rare forms of the irregular type have been described, as the *triple tertian*, with two paroxysms in one day, and one the next; the *double quartan*, with a regular fit one day, a slight one the next, and a complete intermission on the third day. The quotidian is the most common; the quartan the rarest of all—a rule which seems to hold good wherever malarial fevers prevail. The quartan type has been noted from early times for the tenacity with which it clings to its victims.

Premonitory symptoms.—These are much the same as in all febrile disorders—namely, pain in the back and lower extremities, languor, lassitude, gastric irritation, loss of appetite, nausea, and sometimes vomiting; occasionally with frequent calls to micturate, the urine being pale and highly acid. Then follow in succession the three stages, the *cold*, the *hot*, and the *sweating*; succeeded by what is technically known as the *interval* or apyrexial period, which lasts for a number of hours, varying according to the type of the disease.

Cold stage.—The patient experiences a sense of coldness in the back; then rigors set in, at first faintly, becoming quickly more distinct, until the teeth chatter, and the patient feels cold all over, and demands to have clothes heaped on him; the skin shrivels, the nails become blue, and he experiences a sensation of intense discomfort. This feeling of cold is, however, only a 'subjective symptom,' for if a clinical thermometer be placed in the mouth or rectum, even before distinct rigors set in, it will indicate a rise in the temperature of from two to three degrees. The skin, from contraction of the superficial vessels, is indeed colder than natural, but from the first the temperature of the blood is above the normal. The phenomena of the cold stage are gastric irritation, a foul tongue, a rapid pulse, and quickened respiration, with a feeling of coldness not confirmed by the thermometer. A sharp pain in the rectum is sometimes complained of just as the cold stage sets in; attributed by Dr. Lauder Brunton to obstruction to the flow of blood through the hæmorrhoidal veins.

Hot stage.—As this sets in, the patient grows warm all over, the face flushes, the pulse rises in frequency and volume, the skin grows hot, and the patient becomes restless, seeking ease to his aching head, back, and limbs in frequent change of posture. The tongue in this stage is usually dry, often bile-tinted; and the bowels are constipated. The temperature rises to 105°, 106° F., and sometimes higher.

Sweating stage.—At first beads of perspiration appear on the brow and face, and the hands become moist; and soon, to the immense relief of the patient, his whole body sweats freely, the temperature begins to decline, and the paroxysm is at an end. The average duration of the paroxysm is from five to six hours, but in severe cases it may last for twelve hours. When sufferers have been exposed to malaria in such places as the mangrove-swamps of Africa, 'they will be reminded of what their systems have imbibed in the way of surroundings by the sickly scent of the swamps thrown off in the secretion through the skin' (Waller). Both officers and soldiers who came under the care of the writer on their return from the last expedition to the Gold Coast, observed the same fact in their own persons: some were severely nauseated by the unpleasant smell, recalling the stench of the places where the poison was taken into their systems.

Temperature.—The rapidity with which the temperature in ague rises to 105°, 106°, and sometimes even 107° F., and the equally sudden manner in which it falls when the sweating stage begins, is a very notable and characteristic fact of great diagnostic value. According to Wunderlich, nothing like this is to be seen in any other disease, with the exception of cases of relapse in typhoid, or the febrile paroxysms in acute tuberculosis and pyæmia. As soon as the sweating stage begins, the temperature declines, at first slowly, then as rapidly as it rose; when the defervescence is complete, it will be found one or two points of a degree below the normal, where it remains during the period of apyrexia. If the paroxysms be cut short by quinine, we may still detect at the hour of expected attack a distinct rise in the temperature, although none of the other symptoms of a paroxysm may occur, and the patient may be hardly sensible of it.

Pernicious agues.—This term is much used both by French and Italian authors, who apply it to cases both of intermittent and remittent fevers, in which certain symptoms are developed, such as delirium, coma, an algide condition—in a word, any serious complication placing the life of the patient in peril. So far at least as intermittent fever is concerned, this pernicious form appears to be more common in the intensely malarious regions of Italy than in India. Such was the experience of the writer, in whose large sphere of observation such grave complications were almost entirely confined to the worst forms of remittent fever, contracted in places notoriously dangerous. The writer is strongly impressed with the belief that the 'pernicious' symptoms, the mental incoherence and delirium, the coma, and the 'algide condition' so much dwelt on by some Italian physicians of the old school, were often the result, not so much of the disease as of the lowering treatment to which they subjected their patients.

The algide form of 'pernicious' intermittent is sometimes described by writers on the diseases of India as 'ague of adynamic type,' and it was frequently seen and well described by the French military surgeons both in Algeria and in Rome, during the long occupation of that city by the French army. The surface is cold, but, unlike the cold stage of an ordinary ague, the patient is unconscious of the low temperature of the surface. The internal temperature is high, and of this he is aware. There is an immense accumulation of blood in the abdominal viscera, with great thirst. The expression of the patient is tranquil, and his intelligence is intact. 'Il se sent mourir,' says Maillot, 'et l'abattement est tel qu'il se complaît dans cet état de repos; sa physionomie est sans mobilité; l'impassibilité la plus grande est peinte sur le visage' (Maillot, Colin).

Complications. — Intermittents may be complicated by attacks of various diseases of greater or less severity—attacks often governed by climatic causes, by the habits of the individual patient, or by the fact that he has suffered from one or other of such diseases on previous occasions, such as pneumonia, bronchitis, asthma, dysentery, diarrhœa, or epilepsy. It is an old observation that the last-named disease, even in so-called 'confirmed epileptics,' sometimes disappears when the victim becomes the subject of an attack of ague. One very striking example of this kind the writer has seen.

Pneumonia is certainly the most formidable complication met with in intermittent fever. Invalids returning from India or from other hot and malarial climates to high latitudes, unless they are carefully protected by suitable clothing, are prone to suffer from this disease. The rapidity with which consolidation of the lungs takes place in such cases is very remarkable. It is not an uncommon thing to see five or six cases of this kind out of one party of invalids landed at Netley from India, if they have been exposed to cold weather on entering the Channel. If pneumonia is double, recovery is rare, the patients either sinking at once, or dying after a longer or shorter illness from pneumonic phthisis. Pneumonia of this type is a common and fatal disease among the malaria-poisoned civil population of Rome during the winter months; and the French military surgeons record its prevalence in the French garrison there at the same season, and also among malarial invalids sent back to France both from Algeria and Rome (*Recueil des Mémoires Méd. Mil.*, t. ii., 2^e série, p. 268). When pneumonia occurs as a complication of any form of malarial fever, it is one of the gravest import—a fact pointing to the necessity of careful exploration of the chest. Scorbutus is a formidable complication. It is common, although often overlooked, among European and native soldiers in India.

Diagnosis.—An ordinary intermittent presents no difficulties. The well-marked nature of the paroxysms; the sudden rise of temperature and its equally sudden decline; the splenic enlargement; the discoloration of the skin; the urinary changes described above; together with considerations relating to the place where the disease was contracted; and, above all, the therapeutic test—that is, the power of quinine in preventing the recurrence of the attacks—ought to clear up all doubts.

Prognosis.—This, in ordinary agues, so far as immediate danger is concerned, is highly favourable: death from uncomplicated ague is very rare. The direct mortality from ague, at all events among the European races affected by it, is small; the indirect mortality from the malarial cachexia, occurring either *per se* or as a complication of other diseases, is very great. In complicated or so-called pernicious agues, the prognosis will depend on the extent to which important organs are involved—cerebral, pulmonary, or gastric; much on the stage the disease has reached before the patient comes under treatment; and much, very much, on the nature of that treatment.

Treatment.—Keeping in view the fact that every paroxysm of intermittent fever, particularly in a hot climate, is a step, however short, on the road to the cachectic condition described in the article on Malaria, the importance of breaking the recurrence of the paroxysms will be apparent. This, then, is the first indication of treatment; the second is hardly less important, namely, to improve the condition of the blood, and by judicious treatment—therapeutic, dietetic, and climatic—to prevent further degeneration of organs, and, so far as may be, to restore those affected to their normal condition.

If, as the writer firmly believes, there be such a thing as a specific disease, intermittent fever is specific. Like all such, it has a certain definite series of phenomena to pass through, which we cannot arrest. There is no drug known to science capable of arresting the stages of a true malarial fever once it has entered on the first or cold stage. This doctrine, as Sir William Jenner has admirably stated it in his *Address on the Ætiology of Acute Specific Diseases*, has been taught by the writer, as regards malarial fevers and cholera, in his lectures at Netley for the last twenty years. There is little, therefore, to be said as to the treatment of the stages of ague: they must take their course, the only interference being to supply the patient with the warm covering so much desired during the cold stage; if this be protracted unduly, to give him draughts of warm tea; and should symptoms of collapse appear in any of the more 'pernicious' forms at the end of the hot stage, to administer such restoratives and stimulants as the case may demand. Excepting in cases where the stomach is oppressed by a recently taken meal, the time-honoured practice of administering an emetic may be safely omitted. The lamented traveller Livingstone, whose experience of malarial fevers was immense, began the treatment of nearly all cases with the following combination. Of resin of jalap and of rhubarb, from 6 to 8 grains, with 4 grains of calomel and a like quantity of quinine. According to the great traveller and his hardly less experienced companion, the Rev. Horace Waller, this combination was found very efficacious as the commencement of treatment, both in intermittent and remittent fever. In Livingstone's camp his pills were known as 'rousers,' and as such were at once administered to men who, 'from premonitory symptoms, became idle and lethargic.' In about five hours copious dark-coloured motions followed; if these were delayed, recourse was had to a brisk purgative enema. Quinine was then given in 4-grain doses every four hours, until twelve grains were administered in the twelve hours succeeding the purgative medicine. Livingstone and his followers deemed any other mode of dealing with the fevers of Africa to be 'mere trifling.' Common sense points to the necessity of caution in the use of such active purging in men debilitated by disease or climate, or both, or when the patients are delicate women, or Asiatics, often calling for as delicate handling. It is very necessary to add that this sharp treatment is not applicable to those who are labouring, or have previously laboured, under dysentery, or any other form of bowel-complaint.

In the 'interval,' energetic efforts must be made to bring the patient under the influence of quinine. At once the most effective and the most economical plan is to administer quinine, in solution, in a 10-grain dose at the end of the sweating stage, and to repeat it in from four to six hours. At least a scruple of the remedy should be given during the interval. If obstinate vomiting interferes with the retention of the quinine, which will rarely happen if the bowels have been well relieved, the quinine must be administered either by enema or by the hypodermic method. The first plan is very efficacious, and is safe; the latter is more effective, but is not without risk of inconvenience from troublesome ulceration round the site of injection, if a mineral acid has been used to dissolve the quinine; this in urgent circumstances, such as in pernicious agues dangerous to life, or in remittents (as will be explained under the head of that type of fever), might be disregarded were it not that tetanus followed the operation in five cases in one year in the Bengal Presidency, all of them proving fatal. In the face of such a fact, this operation, trivial as it seems, should not be performed on light grounds. The neutral sulphate of quinine, which dissolves freely in water at a temperature of 99° F., does not, so far as the writer's experience goes, cause ulceration. The syringe used for this purpose should be a little larger than that for injections of morphine, and should have a platinum hollow needle, which should be dipped in an antiseptic before insertion. In many cases, more particularly where there is much restlessness and disturbance of the nervous system, marked benefit follows the use of full doses of bromide of potassium with the quinine.

Quinine, in one or other of the methods advised, should be used until the paroxysms are broken. The remedy should be continued daily, so long as the clinical thermometer indicates a rise in temperature at the time of expected attack, even if there be no sign of a regular cold stage; and within a lunar month from the time of first attack the patient should be again brought under the influence of quinine for some days. In pernicious agues, or in cases where complications arise, it is in a high degree dangerous to pause in the administration of quinine, to use remedies of a depressing kind for this or that set of symptoms. Those who so act will have little success in practice until taught by bitter experience the danger of departing from the golden rule of trusting to quinine. In this way, epilepsy, pneumonia, asthma, bronchitis may have to be met, aided by stimulation of the skin, support from proper food, and stimulants when called for. For many years the writer has urged this doctrine on the attention of young practitioners, and he is glad to see that it is even more strongly insisted on by Trousseau in his well-known lectures.

It is in such cases, and in grave remittents, that the *tinctura Warburgi* has been found so useful as to warrant a strong recommendation. The active ingredient in this febrifuge is quinine, in combination with a variety of aromatic drugs, which either are now or were formerly official. It is a powerful sudorific, and has been found in the writer's hands, and in the practice of many medical officers in Southern India, a remedy of great power in all malarial fevers. After opening the bowels, half an ounce of tincture is administered, undiluted, all drink being withheld: a second dose is given in three hours. It soon produces free action of the skin, the perspiration often having an aromatic odour. It is rare to see another paroxysm follow the use of the tincture. In adynamic cases it should be used in smaller doses, and with some caution, lest its excessive sudorific action should be too depressing.[1]

Substitutes for quinine.—The officers in charge of the Government cinchona plantations in India now prepare from the red cinchona bark, by a very simple and economical process, a preparation known as 'cinchona alkaloid,' which, in somewhat larger doses than quinine, is found to be effectual in checking malarial fever; but this preparation, although very cheap, has fallen into disrepute from the distressing nausea, and even vomiting, it often causes.

Salicylic acid is now largely used as an antipyretic in cases of ague.

Arsenic has been used for ages, particularly in the East, in the treatment of agues. There is no doubt that it possesses considerable power as a so-called antiperiodic. The French military surgeons, who are obliged to study economy, use it largely, and in doses much larger than are commonly given by British practitioners. They seek, as Boudin expresses it, to oppose an arsenical to a malarial diathesis. In the brow-aches and other neuralgic sequels of malarial fever it is an effective remedy, either alone or in combination with quinine. The power of arsenic as a prophylactic is much insisted on by Professor Crudeli. The alkaline sulphites, so much lauded by Professor Polli, have hitherto disappointed the expectations of British medical officers who have tried them. In the great epidemic uotbreak of malarial fever in the Mauritius they were found useless. The sulphate of cinchonine in scruple doses is much praised by Dr. Paul Turner. Biberine was largely tried by the writer in India, and found to be inert. Of late, various preparations of *eucalyptus globulus*, the blue-gum tree of Australia, have been much praised in the cure of ague, and more particularly in the treatment of its sequelæ. The writer is inclined to fear that this remedy, like many others, has been unduly vaunted. It certainly is often useful in the malarial cachexia, with occasional attacks of ague, but in the acute forms of the disease it is, in the experience of the writer, of no value. The best form is the tincture. Both in France and Germany it is much used for the reduction of enlarged spleens.

Diet.—This should be nutritious and easy of digestion. Dr. Cornish has pointed out how much the mortality from malarial fevers is increased amongst the natives of India by 'starvation treatment.'

---

[1] Dr. Warburg has communicated to the writer the formula for the preparation of this tincture, which at Dr. Warburg's desire was published in the *Lancet*, and *Medical Times and Gazette.* (See *Medical Times and Gazette*, 1875, vol. ii. p. 540.) As stated in the text, quinine proved to be the active ingredient, in combination with a number of aromatic drugs common to ancient and modern pharmacy. It is consistent with the writer's knowledge that this tincture has maintained its high reputation in the treatment of malarial fevers of the most dangerous type, in the hands of the late General Gordon, in the pestilential regions traversed by him and his officers while carrying out the policy of the Khedive of Egypt in the Soudan.

Treatment of malarial cachexia.—On the first signs of this condition appearing, the sufferer should be sent to a non-malarial climate. If by sea-voyage, care must be taken so to regulate the diet as to avoid the risk of ingrafting the scorbutic on the malarial cachexia. Remembering also the danger of exposure to cold already insisted on, scrupulous attention to clothing is a point of cardinal importance. According to the writer's experience, one of the most effective means of reviving the action of the skin, improving the condition of the blood, and restoring the spleen and liver to a more healthy condition, is to send those whose circumstances admit of it to Carlsbad or Homburg, where, under proper local medical advice, they may drink the waters and use the baths. The good effects of this treatment are often very marked and lasting. It should be supplemented by a course of the syrup of the triple phosphates of iron, quinine, and strychnine, in half-drachm doses three times a day; which after a time should give way to iron in some more direct form. The Carlsbad water, in combination with that of Friedrichshall, if continued for a sufficient length of time, is often most useful in improving the condition of the abdominal organs, even when the patient can only use them in this country; and the action of the skin may be stimulated with profit by the occasional use of a Turkish bath, or by a wet sheet packing. The writer has long used the ointment of the iodide of mercury in reducing enlarged spleens, and often with great success. The strength of the ointment is 13 grains to an ounce of lard. Of this a piece as large as a walnut is to be well rubbed in before a good fire. The process is repeated on the afternoon of the same day, and again, if need be, in a fortnight. If ordinary care be taken to watch the effects, and not to use the remedy too often, no ill consequences need be feared. The writer has in this way again and again reduced spleens, extending even into the pelvis, to almost normal dimensions, without producing any of the inconveniences either of the mercurial or iodine ingredients of the ointment.

It is a point of great importance that patients should be placed under the most favourable hygienic conditions, and breathe the purest air available.

W. C. Maclean.

INTERNAL EAR, Diseases of.—*See* Ear, Diseases of.

INTERSTITIAL (*inter*, between; and *sto*, I stand).—Relating to the interstices of an organ. The term is applied in physiology to the tissue which exists between the proper elements of any structure, namely, some form of connective tissue. In pathology the word is used in connexion with *absorption*, when a part is gradually removed without any obvious breaking off; and also to indicate the implication of the interstitial tissues in morbid processes, or their infiltration with morbid products, as *interstitial pneumonia*, *interstitial hepatitis*, &c.

INTERTRIGO (*inter*, between; and *tero*, I rub).—Definition.—A slight inflammation of the skin occurring in the hollows of folds of the integument or joints, where two surfaces lie in contact with each other.

Ætiology.—The cause of intertrigo is not, as might be implied by its name, friction alone; but rather moisture and heat associated with contact and pressure, acting on a sensitive skin. In certain situations the amount of inflammation is liable to be aggravated by the addition of irritant discharges, such as excessive perspiration, urine, and fæcal matter.

Intertrigo is common in infants, in whom it is favoured by abundance of integument, and sensitiveness of skin. For a similar reason it is met with in corpulent persons; but it is not wanting in the emaciated, when there exists a tendency to eczema, or an eczematous diathesis. In infants it is seen in the perineum, extending from the anal fossa behind to the groins in front, and likewise in any other of the deep folds of the integument. Among adults, in addition to these situations it occurs in the axillæ, in the groove beneath the mammæ, and in the flexures of joints.

Description.—The term 'intertrigo' points to a rubbing together or chafing, fretting or galling of the skin by friction, and no doubt friction may have some share in producing the inflammation; but it is also certain that intertrigo results most frequently from irritation caused by the heat and moisture of the part. Intertrigo has been adopted as an erythema under the name of *erythema intertrigo*, but it very rarely remains at the erythematous stage, having a natural tendency to run on to exudation with the discharge of a muco-purulent fluid, and to be further complicated with excoriations and chaps. In this condition it becomes an eczema, and is very properly treated as such. Indeed, it is more consistent with the genius of modern dermatology to consider it, even from the beginning, as an eczema, under the name of *eczema erythematosum*.

Prognosis.—The prognosis of this affection is favourable as to cure, but uncertain as to time, and in adults it is very apt to degenerate into chronic eczema.

Treatment.—The removal of the cause is the first indication to be attended to in the treatment of intertrigo. This may be effected by keeping the folds of skin apart by medicated cotton wool or old linen rag. The parts should be kept as dry and cool as possible, and dusted with fuller's earth, or any unirritating desiccative powder. Where powder is unsuitable, a lotion of lime-water inspissated with oxide of zinc will be found useful; and if this should prove irritating, zinc ointment, with the addition of a drachm of spirit of wine to the ounce, should be kept constantly applied. Where there is much exudation, it is desirable, as in eczema, to avoid ablution, and confine the treatment to wiping with a soft cloth previously to each repetition of the zinc ointment. Constitutional symptoms are rarely present in intertrigo, but, under any circumstances, the indications to be considered are regulation of the digestive organs and associated functions, a suitable diet, and tonic and antacid regimen.

Erasmus Wilson.

INTESTINAL OBSTRUCTION.—

Synon.: *Ileus*; Fr. *Occlusion Intestinale*; Ger. *Darmverschliessung.*

Definition.—Under this term are included all those cases in which the contents of the intestinal canal are obstructed in their onward passage, by causes or conditions occurring within the abdomen or pelvis. Cases in which obstruction is due to causes or conditions affecting protruding or protruded bowel are included under the head of Hernia.

The subject of intestinal obstruction will be best treated by first discussing *the condition in general*, and afterwards *its different varieties* in detail.

Ætiology and Pathology.—The causes of intestinal obstruction may be enumerated as follows, arranged as nearly as possible corresponding to the acuteness and urgency of the symptoms, and the imminence of danger to life to which they give rise. The relative frequency with which they occur may be approximately estimated by the numbers appended, representing the results of an analysis of 1,839 fatal cases.

1. **Strangulation by Bands or in Apertures** (440).—(*a*) By peritoneal bands, the results of previous inflammatory mischief, either under such bands, or by loops or knots, or in buttonhole-like slits, or by kinking caused by traction, or by the margins of slits and rings produced by the adhesion of organs to one another, or to some part of the parietes (219). (*b*) By the omentum or mesentery forming bands or slits. (*c*) By diverticula or diverticular cords, due to the persistence of the vitelline duct (Meckel's) or of the omphalo-mesenteric vessels, free or attached (75). (*d*) By the appendix vermiformis (42). (*e*) By the margins of peritoneal pouches (retro-peritoneal hernia, hernia through the foramen of Winslow, and other forms of internal hernia) (39). (*f*) By bands resulting from inflammation about the necks of old herniæ.

2. **Volvulus.**—In some cases the intestine is obstructed by being twisted on its mesenteric axis or even on its own axis. In others, the lumen of the intestine is closed by its being intertwined or knotted up together with another portion of the gut (106).

3. **Intussusception or Invagination** (537).

4. **Impaction of Gall-stones** (51).

5. **Contractions.**—Under this term are included those cases in which the bowel is gradually obstructed by matting together of its coils. This may be due to knitting together of one or more coils, by peritonitis, originating, for example, in inflammation of the mesenteric glands.

6. **Stricture.**—(*a*) Cicatricial, from injury or ulceration; (*b*) new-growths (373).

7. **Compression.**—By new-growths, hydatids, &c., outside the bowel (66).

8. **Impaction of Foreign Bodies, or Intestinal Concretions** (78).

9. **Impaction of Fæces. Confirmed Constipation** (78).

10. **Congenital Malformations.**

Seats.—Some parts of the intestinal tract are very much more frequently affected by certain particular causes. Thus, acute obstruction by bands most frequently affects the small intestine; volvulus, the sigmoid flexure. Intussusception most frequently involves the cæcum and colon, and, next, the ileum. Constrictions due to new-growths are most common in the large intestine, especially in its lower portion. Impaction of gall-stones, with very few exceptions, occurs in the jejunum or some part of the ileum. Contractions and traction affect the small intestine and the large about equally.

Symptoms and Signs.—The symptoms and physical signs of intestinal obstruction are, as a rule, sufficiently constant and characteristic to establish the general diagnosis. But it is often very difficult, and sometimes impossible, to determine without exploration the differential diagnosis.

The symptoms and signs common to intestinal obstruction will be first given, and then, more briefly, those specially characteristic of each form.

(1) *Pain.*—Cases of acute obstruction by a band, volvulus, many intussusceptions, or impaction of a gall-stone, are usually signalised by acute pain, often 'doubling the patient up,' and sometimes producing faintness and collapse. Where there has been a period of incarceration, as in some cases of obstruction by bands or in slits, pain supervenes somewhat more gradually, though later it becomes equally severe. In stricture of the large intestine there is, in the earlier stages, comparatively little pain. Again, in obstruction of the large intestine by impaction of fæces the patient complains merely of fulness, weight, and discomfort.

At the onset the pain is doubtless due

to the injury immediately inflicted on the serous and mucous coats, and is very speedily increased and maintained by the effects of the congestion of the blood-vessels on the nerves. This pain will obviously be more severe when the small intestine, with its more intimate association with the nerve-centres and its larger vascular supply, is affected. But it must always be remembered that the severity of the pain depends on the abruptness and completeness of the obstruction, and the extent to which the intestine is involved, rather than upon the variety and cause of the obstruction. Somewhat later comes the pain associated with distension of the bowel itself; this is increased at intervals by paroxysmal exacerbations of acute suffering, which accompany the futile peristaltic efforts of the intestine. Instances of this pain are only too well seen in patients with thin abdomens, in whom attacks of peristalsis, especially when the muscular coat has become hypertrophied, recur after the taking of food, examination of the abdomen, the administration of an enema, &c. Other causes of pain are traction upon inflamed parts, especially when ulceration is beginning to set in; and, at a later stage, enteritis and peritonitis.

With regard to the constant or spasmodic nature of the pain,—when the obstruction is complete the pain is constant, with periodic exacerbations; but with an incomplete obstruction it is likely to be intermittent. An important point to consider is how far the pain affords any guide as to the situation of the obstruction. In the great majority of cases of acute intestinal obstruction, wherever may be the seat of the mischief, the pain is referred to the neighbourhood of the umbilicus, probably because near this spot lies the solar plexus. Thus, in a large number of cases the site of the pain is of little value as a guide. But there are certainly some cases, especially those of acute obstruction by bands, or sudden strangulation in a slit, in which the pain is referred to a region other than the umbilical. Where the pain is accompanied by the occasional uprising of a coil of intestine here, this spot will very likely be a guide to the seat of the mischief. The readiness with which pain may be masked by preparations of opium, and the dangerously fallacious appearance of improvement which may follow; the way in which the distinct localised suffering of obstruction may be merged and lost in the more general and diffused pain of peritonitis; and, finally, the cessation of pain which may occur at the close, when the nervous system is dulled by impending death—need only be alluded to here.

(2) *Tenderness.*—Both in acute and chronic obstruction, tenderness is usually absent until peritonitis has supervened. Patients in the early stages of acute, and still more in chronic obstruction, sometimes state that they find relief from firm compression of the abdomen.

(3) *Vomiting.*—This is a very constant symptom of intestinal obstruction. It may commence almost simultaneously with the occurrence of the obstruction, in which case it is due to the shock of the injury inflicted. Both the vomiting which occurs a little later in acute obstruction, and that in chronic cases much more tardily, recur with greater or less severity, although with sometimes comparatively long intermissions. This vomiting, and its characteristic feature of being liable to become fæculent, have been differently explained. It is undecided how far the obstruction causes the usual peristalsis to be reversed (anti-peristalsis), or how far, aided by the distension of the bowel above and the glandular secretion poured out, it converts the usual passage of intestinal contents into two currents—one, peripheral, in the natural direction up to the point of obstruction, and the other central or axial, which pours the intestinal contents into the stomach. As a general rule, the higher the seat of obstruction, and the more acute the cause, the more severe is the sickness, and the more frequently does it recur. When the obstruction is high up in the small intestine, the vomit is usually bilious and offensively sour, but without the fœtor of fæces. When vomit has been retained for any time, as when the patient is under the influence of opiates, it may have had time to decompose and to acquire a fæculent odour (Treves). Again, true stercoraceous vomit may come from the lower ileum as well as from the colon, for the contents of the lower ileum may, in the natural state, have all the characters of fæces. Moreover, great distension of the intestine may render the ileo-cæcal valve inefficient to prevent regurgitation from the large into the small intestine.

(4) *Constipation.*—This may be absolute from the first, even to the passage of flatus, in acute complete intestinal obstruction, as in that due to bands, apertures, volvulus, or gall-stone.

In other cases, where the strangulation is less abrupt and severe, or where the intestine by some peristaltic movements frees itself for a time, fæcal evacuations may be passed for a while; and a careful inspection of these, especially as to presence of bile, consistency, fæculent odour, &c., may give valuable information as to the degree and seat of the obstruction. In intussusceptions, especially in the more chronic cases, the bowel is rarely altogether impermeable at first, though later it becomes so from the effect of inflammatory swelling. In such cases there is a period in which small quantities of fæcal matter mixed with blood and mucus are passed, frequently with much tenesmus; later on, blood and mucus only are passed. In strictures of the bowel, constipation comes about comparatively slowly, being here replaced by irregular actions, a tendency to diarrhœa alternating with one towards constipation, the motions being altered in shape and size, with passage of blood, &c. Later on, constipation may be rendered absolute by impaction of some undigested article of diet, or by a twist or kink of the bowel above the obstruction.

First among the causes of constipation comes occlusion of the bowel. Another very important one is reflex nerve action. Thus, in cases of acute strangulation, the constipation is often absolute from the very commencement, although the obstruction may be in the small intestine, and much fæcal matter may still be lodged below the point of occlusion. Again, constipation is very usual in those cases of partial obstruction of the bowel where a segment is suddenly and severely nipped. This is well observed, as a rule, in Littre's hernia, where only a part of the circumference of the bowel is involved in the strangulation. Another cause of constipation which must be remembered is paralysis and exhaustion of the intestinal wall.

The following fallacies must be borne in mind. Even after complete occlusion has occurred there may remain in the bowel, below the seat of obstruction, some portion of its contents; and the secretions of the mucous membrane being added, the evacuation of these by natural effort, aided by enemata, may give rise to the false idea that the occlusion is not complete, or that relief has been obtained. Again, the bubbling away of an enema must not be mistaken for the passage of flatus. Finally, false hopes are sometimes raised by the passage of a stool shortly before death. If this has come from above the obstruction, it may be due to some sloughing which has taken place or relaxation of spasm.

(5) *Aspect and condition of the abdomen: Distension, swelling, meteorism.*—The degree of *distension* and its rate of onset vary with the cause and site of the obstruction, the amount of vomiting, the food taken, &c. Thus, in acute obstruction of the lower part of the ileum, distension comes on rapidly and severely; but an even more rapid and a severer distension is seen to follow on one form of obstruction of the large intestine, namely, volvulus. In obstruction high up in the ileum or jejunum, the epigastric and upper regions appear distended, and the lower ones sunk. But in trying to diagnose the site of the obstruction from the distension the greatest caution must be maintained. 'There is a difference in the shape of the abdomen when distended, according as the arch of the colon is below or above the seat of obstruction. In the former case the belly is rounded, projecting well forwards, but with comparatively little fulness of the lateral and lumbar region. In the latter case it is more broad, and, if the hand be placed on the patient's loins as he lies in bed, a feeling of resistance is experienced which is wanting when the small intestine is alone distended' (Fagge). But the same writer gives us the following cautions in interpreting signs. Absence of fulness in the course of the colon is no absolute proof that the disease is high up in the intestine. Again, the presence of fulness in the course of the colon is no proof that the seat of the obstruction is in the large intestine. For in more than one instance a prominence of the epigastrium and the appearance of a large horizontal coil have been due, not to the transverse colon, but to the ileum, dilated until it rivalled the colon itself. The presence of meteorism is, when rapid and severe, most dangerous and distressing.

Apart from the above distension from accumulation of intestinal contents, certain localised swellings in the abdomen may be occasionally recognised. Thus, intussusception commonly gives rise to an elongated sausage-shaped swelling lying in the course of the large intestine. Stricture of the sigmoid may sometimes be felt in a patient with a thin, relaxed abdominal wall, as an indistinct localised thickening. Other instances of tumour are very rarely met with. The fat-loaded abdominal walls usually met with in a sufferer from impacted gall-stone prevents this cause of obstruction being felt by palpation. A localised swelling will be of more value as a guide if pain has also been referred definitely to this same particular spot. A number of coils of small intestine, matted together by adhesion, may form a kind of tumour, and localised dulness on percussion has been caused by collapsed coils of small intestine grouped together below an obstruction (Treves).

(6) *Peristalsis.*—The fact that the movements of the intestine can be clearly recognised in some cases may be of much help in the diagnosis. One coil may be seen rising up and becoming prominent, and then sinking down and giving place to another, and sometimes waves of action, as it were, seem to pass along a considerable length of bowel. Such movements recur at irregular intervals, and are accompanied by gurgling noises (borborygmi) and sensations, and by exacerbation of suffering. This peristalsis, as Dr. Fagge pointed out, is characteristic of the chronic varieties of obstruction, in which the coats of the bowel have undergone hypertrophy. It also indicates an absence of peritonitis. While peristaltic movements are much more often seen in the small than in the large intestine, they may sometimes be observed in the latter. Dr. Fagge also pointed out, as worthy of especial note, that the large intestine, when distended, does not continue to lie horizontally across the upper part of the abdomen, but bends downwards, and may form a broad loop, lying vertically and (with

the dilated ascending and descending colon) filling the whole front of the abdomen. On the other hand, the coils of the ileum are, under similar circumstances, generally arranged transversely; and, as these coils are often quite as broad as the transverse colon, the uppermost one, lying horizontally just below the ribs, may easily be mistaken for that part of the large intestine.

(7) *Diminution of urine.*—In acute obstruction the urine is diminished in quantity. This fact has been differently explained. The late Dr. Barlow considered that it pointed to a site of obstruction high up in the jejunum, the area for the absorption of fluid being thus much diminished. Later on, Dr. Habershon attributed it to the urgency of the vomiting which occurs in acute obstruction high up. Dr. Fagge, following Dr. Sedgwick, argued that this symptom is merely one of the phenomena of collapse, and will occur in all forms of intestinal obstruction, whatever their seat, in which collapse is present. But as it is obstruction of the small intestine in which collapse is often present, while in that of the large bowel it seldom occurs, suppression or diminution of urine is common in the former, rare in the latter, condition. When the obstruction is low down there is no marked diminution in the quantity—there may even be an excess—of limpid urine, with sometimes a difficulty in voiding it.

(8) *General aspect and symptoms.*—In cases of acute obstruction, often from the first, and in the later stages of both acute and chronic obstruction, the general aspect of the patient is more or less characteristic. A condition of collapse frequently occurs; and when this appears *early* it is due to the shock of the injury, and is usually proportionate to the nerves and the amount of intestine involved, being more marked in the case of the small than of the large intestine; and, above all, to the abruptness and severity of the obstruction. The countenance is expressive of anxiety and distress; the eyes are sunk, often with dark circles round them, the nose pinched, the cheeks hollow, the lips pale or purplish, and the complexion faintly livid; the general surface is cool or cold (the ears, forehead, nose, and feet first becoming cold), and often covered with a clammy perspiration. Although the mental faculties are as a rule undisturbed, there is a disposition to torpor, from which the sufferer is from time to time aroused by exacerbations of pain, or recurrence of vomiting. The pulse is frequent and small, and towards the end becomes thready. The temperature is rarely above normal unless peritonitis sets in; usually it is normal or subnormal, sometimes falling to a marked extent. Sometimes there is more or less dyspnœa, which may be explained in part by pressure upwards of the diaphragm by the distended bowel below, and the latter cause often gives rise to distressing hiccough. The voice varies, being feeble or whispering, or strong and full quite up to the end. The tongue becomes red, and later dry and brown. Towards the close there is often a combined odour of offensive sweetness and decomposition in the breath. The patient suffers from severe and constant thirst, which often he fears to assuage lest vomiting should be provoked.

In most cases the course is one of progressive emaciation, weakness, and exhaustion, the end being often preceded by peritonitis. In some exceptional cases death has been preceded by mild delirium and coma; and in others, still more exceptional, by violent delirium and convulsions, the latter being especially likely to be met with in little children suffering from intussusception.

COURSE, COMPLICATIONS, AND TERMINATIONS.—In the acute forms of intestinal obstruction the prospect of recovery is extremely slight; perhaps, in the large majority of cases, it would be just to say that practically there is none at all. And here a word must be said as to those extremely rare instances of spontaneous recovery which have occurred from time to time under every form of acute obstruction, volvulus only excepted. Very much of the value of these cases has been lost by their after-histories not being published, chances thus being lost of our knowing in what cases of certainly mechanical obstruction spontaneous recovery is really possible. In the second place there is strong reason to believe that in several of these cases the diagnosis has been at fault, the real cause of mischief being peritonitis, *e.g.* starting from the cæcum or its appendix, or one originating in tubercular mischief, an enteritis, and not one of mechanical obstruction.

In the more chronic forms of obstruction, with the exception of those depending upon impaction of fæces, and some others, perhaps (as chronic intussusception), death, though considerably longer delayed, ensues sooner or later, in spite of temporary relief afforded by operative measures or in other ways.

In cases of acute strangulation, in which the occlusion has been sudden and complete from the first, and in which timely relief has not been obtained, the average duration has been found to be from three or four to five or six days. In the cases reported as fatal within a few hours, it is possible that the case has been one of perforation of the intestine or stomach, rather than one of obstruction of the bowels (Fagge). Where the case is one of incarceration at first, followed by actual strangulation, death may not occur until after the lapse of eight or ten days. In cases of constriction or compression in which complete occlusion has come about gradually, or even has not been finally established, the duration of life varies greatly according to the complications which arise, and it may be prolonged for weeks or even months. So, too, in cases of stricture of the large intestine, where the patients are of average intelligence, when they avail themselves regularly of medical supervision, and are amenable to the directions given, especially in the matter of diet, the end may be deferred for one and a-half or two years or more.

The *complications* and *accidents* that are liable to occur are: Peritonitis starting from the seat of the lesion, and more or less rapidly spreading and becoming general; enteritis; ulceration and perforation of the bowel; sloughing of the strangulated or intussuscepted portions; hæmorrhage into the peritoneal cavity or into the bowel; sudden asphyxia or broncho-pneumonia, due to the entrance of vomit into the air-passages; pyæmia or septicæmia from the absorption of decomposing material; gradual asphyxia from the interference with respiration by abdominal distension; anæmia; coma; and syncope from cardiac depression and cerebral anæmia.

DIAGNOSIS.—Nowhere does successful treatment depend more intimately on correctness of diagnosis; nowhere is a correct diagnosis more invariably difficult; nowhere is it so often impossible. We can only hope to arrive at it by careful attention to the following points, and by striving to keep before us a mental picture of the different hidden possibilities which may lie at the root of the mischief.

The following questions must be considered: I. *Is the obstruction acute or chronic?* II. *Where is the obstruction situated?* III. *What are the best methods of investigation?* IV. *What are the diseases most likely to be mistaken for intestinal obstruction?* V. *Is the case one favourable or unfavourable for operation?* This last question will be considered later under TREATMENT.

I. *Is the obstruction acute or chronic?* The symptoms given as distinctive of the two groups are often misleading when applied to individual cases.

(1) Under *acute obstruction* would be included the following: (*a*) Strangulation by bands or through apertures; (*b*) volvulus of the colon; (*c*) acute intussusception; (*d*) impaction of a gall-stone in the small intestine.

SYMPTOMS.—Pain sets in suddenly at a definite time, being generally referred to the neighbourhood of the umbilicus, whether agonising or colicky; it is usually paroxysmal at first, but tends to become continuous. It may have followed an unwise meal, going to work, some straining effort, active purgation, or a blow. Vomiting is early and severe—first the contents of the stomach—then bilious, excited by any effort to take food—and ultimately brownish, foul-smelling, or more completely stercoraceous. Constipation is absolute, even to the passage of flatus, though small scybalous matter may come away from a point below the obstruction after enemata or straining efforts of the patient. The abdomen soon becomes distended, but its form presents little that is really distinctive of one form of obstruction rather than another; this being largely due to the facility with which one or two distended coils may be displaced into areas where they conceal the proper contents, and simulate their distension. The urine is diminished or suppressed. The collapse, the state of the tongue, pulse, and temperature are as already stated.

(2) Under *chronic obstruction* would come: (*a*) Stricture of the large intestine; (*b*) contractions or adhesions obstructing the intestine (usually small) by bending, dragging on, narrowing, or matting up one or more coils; (*c*) stricture of the small intestine after ulceration—traumatic, tubercular, or malignant; (*d*) chronic intussusception; (*e*) obstruction by compression of growths from outside; (*f*) fæcal impaction.

SYMPTOMS.—In chronic obstruction these are characterised by their slow, irregular development. The pain comes on at first at long intervals, corresponding to troublesome attacks of constipation, and is put down to 'attacks of wind,' colic, or indigestion. Even late in the case fixed pain is often absent; but pain occurs in paroxysms which correspond to attacks of peristalsis, showing the writhing movements of intestine, with muscular fibre hypertrophied, and as yet not stilled by peritonitis. Constipation is for some time the chief trouble: the bowels never act satisfactorily without aperients. Constipation alternates with diarrhœa; or broken up or narrowed bits, unsatisfactory alike in form and bulk, are passed with difficulty, accompanied by much flatus and some loose motion. After one or more attacks of obstruction more or less complete, the contracted lumen of the bowel may be absolutely blocked. Vomiting is often long deferred, and the patient may keep comparatively well (with clean tongue, sleeping well, and taking food), even when his condition has become one of great danger.

While the above description applies to well-marked acute and chronic obstruction respectively, the two forms do not always fall into such distinct groups. Further, the above terms do not always correspond to obstruction of the small and obstruction of the large intestine. All the symptoms of chronic obstruction, lasting over six months, may be presented by a case of obstruction of the ileum from cancerous puckering of its mesentery; while, on the other hand, every symptom of the acutest obstruction of the small intestine, ending fatally in four days, may be shown by a volvulus of the sigmoid (Fagge). Again, the greatest difficulty in deciding between acute and chronic obstruction may be caused by a patient, whose age suggests malignant stricture of the large intestine, and in whom absolute constipation, a greatly distended belly, and evident peristalsis call loudly for relief, definitely declaring that the constipation is merely a matter of a few days, and denying absolutely any previous attacks of constipation or obstruction. Finally, there is a third class in which an attack of acute obstruction supervenes upon symptoms indicating a chronic obstruction. Such condition most frequently occurs in patients with malignant stricture, or with coils matted together by adhesions, with chronic intussusception, or gradual occlusion of the lumen of the bowel by a growth within or outside its walls, the actual obstruction being brought about by some sudden blocking, as by a fæcal mass, or by kinking or bending of the bowel above. The chief help in the diagnosis is given by examination of the patient's history. There will usually be an account of symptoms pointing to chronic obstruction, with previous less severe attacks.

II. *Where is the obstruction situated?*—It may be said at once that a case of chronic obstruction is usually one of the following: (*a*) Stricture in rectum, sigmoid flexure, splenic or hepatic flexure; (*b*) stricture of the small intestine from mischief within its lumen, or from matting, kinking, or dragging on it by adhesions, &c., outside; (*e*) chronic intussusception; (*d*) fæcal impaction. Of the above, obstruction of some point in the left side of the arch of the large intestine is by far the most frequent.

With regard to acute obstruction, usually in the small intestine, it must be confessed that it is very frequently quite impossible to go beyond localising it in the small intestine. It has been shown that the urgency of the chief symptoms is not related to the seat of the obstruction, but to its severity. No doubt obstruction high up in the small intestine will in many cases be accompanied by earlier vomiting, but less likely to become fæculent. Distension of the abdomen will be less in a case like the above than in one where the obstruction is low down in the ileum. The numerous fallacies which may beset us, depending on the amount of food taken, the influence of drugs, the erratic manner in which one or two coils may cause distension of an area at some distance from their proper habitat, must be borne in mind. It will be wiser to be content in acute obstruction with determining whether it is in the small intestine, as by a band; in the large, as in volvulus; or in both, as an acute intussusception —and to remember that all beyond may be blind guesswork.

III. *What are the best methods of investigation?*—A correct diagnosis can often only be arrived at by most careful attention to the following points. Trivial as some may seem, all or any may be of the utmost importance; and as cases of acute obstruction may vary every hour, carefully repeated examinations may be needful to throw light on a condition which was quite obscure a few hours before.

(*a*) *The History.*—The value of this is often nil, but the smallest point may sometimes be of the greatest importance. Thus (i) *previous peritonitis* may lead to a suspicion of strangulation by a band, or by multiple adhesions. (ii) *Injury*, such as a kick from a horse, may have led to a rupture and subsequent hole in the omentum, thus causing later on a seat of strangulation; or to obstruction from cicatrisation of some bruised loop of intestine. (iii) *An imprudent meal* of heavy and indigestible food may determine the occurrence of obstruction, by the sudden formation of gas and turbulent peristalsis in cases of peritoneal adhesions, or stricture, by causing twisting or kinking. (iv) *Old-standing hernia.* Adhesions formed about the neck of an inguinal hernia may strangle a loop of small intestine quite independent of the hernia.

(*b*) *The Symptoms.*—These are next to be investigated. The symptoms characteristic of acute and chronic obstruction respectively, and their fallacies, have been already given.

(*e*) *Physical Examination.*—The most careful and thorough examination of the abdomen by palpation and percussion, and by exploration of the rings, the rectum, and, if need be, the vagina, should be instituted at the earliest practicable period, before general abdominal distension or the supervention of complications has obscured the indications first presented. The form of the abdomen is to be first studied. Then, any fulness which remains localised, especially if accompanied by abiding pain in the same place, any limited dulness, any repeated upspringing of one or more coils at the same place (especially if it is noticed that borborygmi are arrested here), may all be of value in helping to localise the seat of obstruction. In some cases it may be desirable to administer an anæsthetic, to facilitate the examination by relaxing the abdominal muscles, and to save additional suffering. But this step may be dangerous if vomiting is easily excited. With regard to the rings, the regions of umbilical, inguinal, femoral, and even obturator hernia should be carefully scrutinised. Not only may the modesty of a patient have led to the concealment of an ordinary hernia, but possibly a small knuckle may be tightly strangled in the neighbourhood of the internal ring, or in the canal, or the lumen of a piece of intestine may be partially closed in a tiny femoral hernia. As to the need of a rectal examination, it is only too certain that even nowadays this method of examination is still too much neglected, and thus intussusceptions are sometimes overlooked until it is too late to reduce them by insufflation; and cases of malignant stricture are allowed to go on, and treated as indigestion, flatulence, or constipation. The introduction of the whole hand into the rectum has been rightly given up of late years; the information it gives is very limited, and only obtained at grave risk. Exploration *per vaginam* is often no less needful than that *per rectum*.

(*d*) *Use of Enemata and the Long Tube.*—The employment of these methods is often as useless in diagnosis as in treatment. Further, their use is often accompanied by danger, and may be misleading also. Finally, they frequently weaken and distress the already sufficiently handicapped patient. The following dangers and fallacies accompany their use: (i) An obstruction may be pervious to fluid from below and not from above (Fagge). In such a case the fluid pumped through may easily add to the accumulation above this point. (ii) When the abdomen is distended, the administration of large enemata must add to the misery of the patient. (iii) Further, the passage of an enema tube and the amount that can be injected may be misleading also. Thus, it is well known that the tube may be stopped by a fold of mucous membrane; or it may double on itself, thus leading to the belief that no obstruction exists within reach. Dr. Brinton thought that with a maximum injection of a pint the obstruction might be referred to a point not lower than the upper end of the rectum; one and a-half, two, and three pints belonging to corresponding segments of the sigmoid flexure. But it is obvious that the sources of fallacy—leakage, admission of air, the varying capacity of the rectum in different patients, &c.—are numerous. The use of enemata will again be alluded to under TREATMENT.

IV. *What are the diseases most likely to be mistaken for intestinal obstruction?*—Of these, the most important in frequency and gravity is peritonitis—especially that form due to mischief in the cæcum or the appendix, or a peritonitis of tubercular origin. Pain, vomiting, constipation, and tenderness may all be present and lead to the greatest difficulty in diagnosis. The points most likely to help are the following: (1) *The previous history.* Thus, though the onset may appear to be sudden, there will very likely have been attacks of 'stomach-ache,' irregular action of the bowels, and tenderness in the right iliac region. (2) *The temperature.* This is usually high in acute peritonitis; but, unless the case is seen early, it may be, as in intestinal obstruction, inclined to subnormal if prostration or collapse have set in. (3) *The vomiting* is usually less urgent in peritonitis, and more rarely fæculent. (4) *The constipation* is less absolute. (5) There is usually diffused *tenderness and distension* in peritonitis. (6) There is no *peristalsis.* (7) *The abdomen* in peritonitis is often 'smooth, firm, and barrel-like' (Hutchinson). Other conditions occasionally simulating intestinal obstruction are lead colic, hepatic or renal colic, enteritis: conditions bringing about an arrest of action but not mechanical obstruction, and to be distinguished by the history and progress of the case.

TREATMENT.—Methods of treatment will be first described, as tentative measures for relief are often called for before any definite conclusion as to the precise cause of the trouble can be arrived at.

A. NON-OPERATIVE TREATMENT.—1. *Purgatives.*—As a rule almost without exception, in acute or subacute cases, the use of all kinds of purgatives is to be emphatically condemned. They aggravate symptoms; while they are liable to light up quiescent into acute trouble, and convert chronic mischief into acute. Threatening sloughing or perforation may also be rendered imminent. It is only where all urgent symptoms have subsided, or, in more chronic cases, where there is no evidence of peristalsis or of peritonitis, that mild laxatives, especially some salines, often prove of great value, but great caution is necessary in their administration. These points, together with the use of stronger aperients in obstruction from fæcal impaction, will be alluded to later.

2. *Sedatives.*—Opium and belladonna, conjointly or separately, are the most useful and reliable medicines we possess, as in the usual combination of opium gr. $\frac{1}{2}$–gr. 1, and extract of belladonna gr. $\frac{1}{6}$–gr. $\frac{1}{4}$, every three or four hours. But it must be remembered (1) that our knowledge of the action of these drugs on the inhibitory and accelerating nerves of the intestine is by no means complete. (2) That we are here especially in the dark. Thus, if we could tell the nature of the obstruction, how the coils lay, and which of them were capable of usefully directed peristaltic action, we might usefully employ belladonna in large doses. In other cases, where ulceration might be threatening, opium alone would be employed. (3) That while opium undoubtedly allays the pain, checks violent and hurtful peristaltic movements of the intestines, dulls the acuteness of the patient's mind constantly alive to his anxieties and distress, while it promotes sleep and thus husbands his strength, it is an entire mistake to speak of opium by the often-quoted phrase 'as our sheet-anchor' in intestinal obstruction. It may dangerously modify symptoms and signs; thus, a patient drugged with opium may be quite unaware that the tenderness of his abdomen is increasing. It may apparently so improve the condition that an operation, later on proved beyond a shadow of a doubt to have been the patient's only hope, is put off till it is too late. In other words, while symptoms are lessened, the condition of the intestine may be hourly getting worse. (4) Adult

patients often show remarkable susceptibility to belladonna; and the excitement which may follow an over-use of this drug in these cases may be most harmful to the patient. (5) In administering opium and belladonna we must be content with the smallest possible doses, especially of the former. In other words, the patient must be judiciously prescribed for, and not drugged. Later on, when operation is declined or set aside, it may be needful to give opium in larger doses, especially if peritonitis be present. (6) There is a certain class of adult cases of intestinal obstruction in which belladonna, in much larger doses than are usually tried, has been most successful. Thus, in more chronic cases, one or two grains of extract given every hour till from five to fourteen grains have been taken, have been followed by relief (Kerr, *Brit. Med. Journ.*, ii. 1878, p. 307).

Opium and belladonna should be administered by the mouth in the absence of contra-indication; but, if vomiting is severe and frequent, by subcutaneous injection of morphine and atropine. Their administration by suppository is the least satisfactory of all methods in cases of acute obstruction. In a few very acute and painful cases the inhalation of an anæsthetic may be asked for; it must always be remembered that this course, while temporarily relieving suffering, and perhaps enabling the case to be further cleared up, has certain inherent dangers of its own.

3. *Diet.*—Sufficient care is still but seldom taken in this simple matter, and the patient is allowed to add needlessly to his misery and danger. In acute obstruction, whenever the diagnosis is suspected or established, it is much best to cease feeding altogether by the mouth, and to trust to nutrient enemata. The small intestine and the stomach itself are liable to be gradually filled up by an ascending column of fluid, and vomiting is thus constantly impending; and when it has already set in, it is only made worse by giving food by the mouth. As a rule, nothing whatever should be given by the mouth save a little ice in small cracked pieces. Nutrient enemata may be made on some such plan as—milk ℥ij, brandy or port wine ʒss., yolk of one egg, with liquor pancreaticus (Benger) ʒj, or a few drops of diluted hydrochloric acid and a little pepsin—the whole being gently warmed, but not cooked. Simple enemata of strong beef-tea, only just liquid, may be given every two, three, or four hours. After, or in place of either, a nutrient zymimised suppository may be inserted. Before an enema is given, it must be ascertained that the rectum is empty. Thirst is best met by the use of ice and the frequent moistening of the patient's lips. Large liquid enemata sometimes relieve thirst markedly, but the objections to these have already been given. When it is clear from the failing pulse, the falling temperature, the cold extremities, the dry tongue, and most fœtid breath that trusting to nutrient enemata is not sufficient, limited quantities of champagne, brandy and soda-water, or some kind of meat juice must be given by the mouth.

4. *Enemata.*—In intussusception and fæcal impaction, and in cases of stricture with a fæcal block above, large enemata are invaluable; but with these exceptions, and especially in all acute cases of obstruction, they are very rarely useful, and are only to be employed with the very greatest caution.

5. *Local applications.*—Material relief is often given by the assiduous use of quite hot applications, regularly renewed, on lint or flannel, wrung out of very hot water, to which preparations of opium, belladonna, and conium or hyoscyamus have been added. Poultices are too heavy, and quickly get cold. Turpentine is sometimes applied on hot flannels. It has the objections of frequently slightly blistering the skin, thus rendering it tender for examination, and perhaps interfering later with the incision of an operation. In a few cases the patient experiences greater relief from local cold, as by cracked ice applied at frequent intervals between two layers of flannel tacked together with a few stitches.

6. *Electricity.*—This is occasionally of service in fæcal impaction.

7. *Abdominal taxis.*—This method has been strongly advocated by Mr. Hutchinson. He believes it to be a fact that the conditions in the early stages are such as to admit of the very easiest replacement. 'The first point is the full use of an anæsthetic so as to obliterate all muscular resistance. Next (the bowels and bladder being supposed to be empty) the surgeon will forcibly and repeatedly knead the abdomen, pressing its contents vigorously upward, downward, and from side to side. The patient is now to be turned on to his abdomen, and in this position to be held up by four strong men, and shaken backwards and forwards. This done, the trunk is to be held feet uppermost, and shaking again practised directly upwards and downwards. Whilst in this inverted position, copious enemata are to be given. The whole proceeding is to be carried out in a *bonâ fide* and energetic manner.'

Abdominal taxis to the extent just described has not hitherto recommended itself to the majority of English surgeons. To many minds conditions will occur in which this procedure, practised, as must be the case, with a certain amount of violence, though carefully and skilfully, will do harm and not good. Thus, if it does not release a loop, it may quite possibly drive one farther on, or send more than one beneath the obstruction. Those who, like the writers, believe that in many of the acuter cases softening and commencing sloughing have very early set in at the seat of strangulation, may well hesitate to recommend this method. Finally, it must be most strongly insisted on that it is only in the very early stages of acute obstruction that this method of abdominal taxis can generally be safely used; and that evidence of peritonitis, a condition notoriously difficult of diagnosis, absolutely contra-indicates it.

B. Operative Treatment.

Surgical Operations.—These include—(1) *Abdominal section*; (2) *Puncture*; (3) *Colotomy.* Of these, colotomy will be referred to under the treatment of chronic obstruction.

1. *Abdominal Section.*—The advisability of this procedure is a matter which concerns physicians as well as surgeons, and especially the practitioner who is called upon to meet one of these most grave cases single-handed.

A few most important points, many of them fallacies still unrecognised, first call for attention: (1) Acute and chronic obstructions do not always fall into distinct groups. (2) Chronic obstruction often puts on an acute appearance. (3) The demand frequently put forward at the present day that cases of acute intestinal obstruction are surgical only, is a mistake. Not only are there difficulties in distinguishing between acute and chronic obstruction, but the existence of obstruction at all may be questioned. The possibility of typhlitis, peritonitis, or enteritis being at the root of the mischief has been already alluded to. But it is right that a surgeon should be called in as early as possible, not because he will desire to operate early in every case, but because it is only fair that he should see the case early and throughout. If the time should come when an operation is decided upon, the surgeon will be in a far better position than when called in, as too often happens, late in the case. (4) It is probably a mistake to expect a large proportion of successes, even after early operations for intestinal obstruction. Many leading surgeons have held strongly that the chief cause of the great mortality after operations for intestinal obstruction has been in their having been put off too long. The mistake here consists in grouping all cases of acute intestinal obstruction together as all suitable for operation. Now *post-mortem* evidence shows that a large proportion are from the first hopeless of relief by operation, others becoming hopeless so early in the case as to render any operation futile. Thus, with regard to operative treatment, cases of acute intestinal obstruction may be divided into these three groups: (*a*) *Cases probably hopeless from the first—e.g.* some cases of severe volvulus of sigmoid and colon; some cases of acute intussusception in infants; and cases of complicated snaring or matting, as in peritonitis started about the female pelvic organs, or in inflammation around mesenteric glands. (*b*) *Cases in which there is hope of doing good by operation—e.g.* cases of band, especially the single band in young subjects; some cases of intussusception, and of internal hernia. The question of benefit from operation in acute obstruction is intimately bound up with these two points: (1) the impossibility of making an accurate diagnosis of the nature or the site of the obstruction in many cases; and (2) the peculiar structure of the parts; thus, the intimate association of the intestine with the nervous system, the weakness and easy paralysis of its propelling power, and the readiness with which it is strangled, &c. Finally, amongst the conditions which handicap the explorer are (*a*) the tightness with which his hand is gripped by the abdominal wall here, not stretched as by a large ovarian tumour; (*b*) the way in which distended coils of intestine crowd up and get in the way; (*c*) the risk of fatally disturbing parts already known to be damaged; (*d*) the condition of the patient. If an operation is to be performed, the pulse should be fair, the temperature not falling, the abdomen not much distended, and with sufficient peristalsis to make it probable that there is little or no peritonitis. On the other hand, the operation should not be performed, as it too often is, on the merest chance of relief, when the abdomen is enormously tympanitic, when the temperature and pulse are falling, and the patient passing into irrecoverable collapse.

The Operation.—Only the chief points can be noted here. The bladder being emptied, and the abdominal wall shaved and cleansed, the patient, with his extremities warmly clad, is placed on a water-bed filled with hot water. Everything that can possibly come within the field of operation must be scrupulously cleansed before the operation, and kept aseptic. An anæsthetic being given, the abdomen is quickly opened along the linea alba below the umbilicus; and all hæmorrhage being arrested, two or three fingers are introduced, and the following possible sites of strangulation first looked to: (1) The cæcum, its condition of distension or emptiness telling whether the obstruction is below or above it. (2) The inner aspects of the femoral, inguinal, and obturator apertures, to make sure that no tiny hernia exists, imperceptible from the outside. (3) The brim of the pelvis, as bands of omentum are often fixed hereabouts, and also because, in women, local peritonitis, originating in the uterus or its appendages, is not infrequently the source of the obstruction. If the above search with two or three fingers or the whole hand fails, and it often will when distension is present, embarrassing the fingers in their movements and obscuring the relation of parts, one or two loops which lie nearest the wound should be scrutinised and followed in the direction of increasing congestion and distension, thus leading to the obstruction. If this prove fruitless, the most distended portion of the intestine must be drawn out (under cover of a new towel, wrung out of hot carbolic acid solution 1 in 60, or of boric acid 2 per cent.) bit by bit from the upper part of the wound and passed in again, after examination, into the lower angle, in such a way that at no time are more than five or six inches of intestine exposed. After drawing out and replacing some feet of intestine in this way, it is probable that, owing to the increasing congestion or resistance, the surgeon will reach the obstruction. An assistant should hold the coil from which the surgeon starts under a hot sponge, to prevent the same ground being traversed a second time. If after five to ten minutes' search the mischief is not found, the surgeon must decide between making an artificial anus and closing the wound, or allowing all the coils to prolapse under hot aseptic towels, frequently renewed. The decision must turn on the condition of the patient, and the amount of distension, it being exceedingly difficult to get distended coils back into their home, and the needful manipulations necessarily producing much shock, and perhaps inflicting serious damage. When the obstruction is found, it must be dealt with according to its nature; thus an opening (as in the mesentery) must be stretched with the finger-nail and the bowel withdrawn; omental bands, if not torn through, divided between two chromic gut ligatures; any diverticular band brought up into view, and divided with similar precautions, or, if the patient's condition admits of it, resected and the cut ends cleansed and closed. Intestinal anastomosis, by Senn's plates, or Paul's modification, will be resorted to where the choice lies between resection and making an artificial anus. The best mode of dealing with volvulus, intussusception, and gall-stone, are given under their respective headings. The peritoneal cavity must next be cleansed, if needful, either by sponges or by flushing with a hot solution of boric acid or salicylic acid ($\frac{1}{3}$ per cent.), or boiled water, introduced by an irrigating tube. In these cases a Keith's tube should be introduced.

1*a*. *Formation of an Artificial Anus; Enterotomy.*—This is done under two chief conditions: (*a*) When the operator cannot detect the site of obstruction, or finds that he can neither deal with this nor perform resection, he then makes an artificial anus in the middle line. (*b*) When it is decided, owing to the patient's condition, not to perform an ordinary abdominal section, but to relieve the distension, &c., by opening the bowel above the obstruction, Nélaton's operation is usually adopted. Neither is more than palliative; and neither should be resorted to, save when other steps fail or are impracticable, and when it is certain that the obstruction is low down in the small intestine. The chief drawback to this method lies in the extreme annoyance the patient suffers afterwards from the continual escape of liquid fæces. If when proposing to make an artificial anus it is absolutely needful to open the bowel at once, this may be effected by a small sharp trocar, the cannula being left in and plugged, or by making a small incision in the gut, turning the patient on one side, and washing away the escaping fæces with boiled water.

2. *Puncture of a Distended Coil by Trocar and Cannula.*—This method is still more merely palliative; it is done still more in th dark; and, though it has given marked relief in some cases, it is not without serious risks. While in a very few cases puncture has apparently proved curative, there is no doubt whatever that the number of cases in which this method has been fruitlessly employed, and which have never been published, is infinitely greater. It should only be employed where the distension and pain are very great, or where abdominal section is refused or unadvisable; and the practitioner and friends should be made well aware of the risks. The chief amongst these are: (*a*) Not hitting the right coil; thus one (though distended) may be hit so far from the obstruction as to give no real relief. In not a few the bowel below the obstruction may be punctured (Treves). (*b*) The puncture may give rise to no real relief, but to increased distress. (*c*) The puncture may be followed by fatal leakage into the peritoneal cavity.

VARIETIES. — I. **Strangulation by Bands or in Apertures.**—As some at least of these depend upon the results of previous inflammation, it is important to inquire minutely into the early history.

ANATOMICAL CHARACTERS. — The bands causing strangulation may be adhesions resulting from peritonitis, omental, a persistent Meckel's diverticulum, or some normal structure abnormally attached. In any case it is the small intestine, and usually the end of the ileum, which is especially liable to become thus strangulated. A band or bands, sometimes rounded, sometimes flattened, may stretch from one part of the mesentery or omentum to another, or, oftener, may be attached by one end to the omentum or mesentery, and by the other to the bowel (only exceptionally to the large intestine), or to the abdominal wall or pelvis. Much more rarely are they found passing from one part of the bowel to another. The broader adhesions sometimes present slits in which portions of bowel may be caught. Similarly, ruptures or slits may occur in the omentum or mesentery, or even in very rare instances in the suspensory ligament of the liver, or broad ligament of the uterus. The lower attachments of the omental bands are usually to the parietes or viscera, to the brim of the pelvis, or to near the inner orifice of one of the rings. Of the diverticular bands, the most important is the one called 'true,' which is due to a persistent or partially obliterated vitelline duct. This band is single, and is attached at one end to the ileum from one to three feet from its termination; its other end may be free or attached in the vicinity of the umbilicus. Its structure may be like the intestine, or cord-like. The intestine may be strangled beneath it, when the band is adherent at both extremities, or snared and knotted up by it, in a much more complicated way, when its distal end is free. Other congenital bands may arise from the omphalo-mesenteric vessels. Strangulation may, much more rarely, take place in various forms of internal hernia (hernia into the foramen of Winslow, or into peritoneal pouches, mesocolic, duodeno-jejunal, or retro-peritoneal).

Ætiology.—Strangulation of the small intestine by the above-mentioned bands or apertures is most commonly met with in early adult life, the average age being from twenty to forty. One sex does not appear more liable than the other, except in the case of strangulation by diverticula, which has been observed about twice as often in the male as in the female subject. The more youthful the patient, the more will a true diverticulum suggest itself. But strangulation is not unknown in much older patients, as shown by the subjects of herniæ and omental bands.

Symptoms.—These are similar to the symptoms already described under Acute Obstruction.

Treatment.—If the ordinary measures fail, the surgeon may resort to abdominal section with much hope—especially if the age or anything in the history pointing to previous peritonitis make it probable that a single band is present. As to the date of interference, the earlier the better, before the patient's strength is lowered by vomiting, and the operation rendered additionally difficult by distension.

II. Volvulus.—By this is meant a folded or twisted condition of the intestine, which closes its canal. In one form, the only common one, the sigmoid is twisted upon its mesenteric axis. In other forms the intestine, again usually the sigmoid, is intermixed with some adjacent coil of small intestine. Very rarely the twist takes place not on the axis of the mesentery, but on that of the intestine itself. A few cases are on record in which the small intestine—*e.g.* the lower part of the ileum—has been the seat of the volvulus.

Symptoms.—In addition to the usual symptoms of Acute Obstruction, there are certain special points which may aid in the diagnosis. The patients are usually adults; and constipation has most likely been of long standing and habitual. The symptoms are urgent (with the exception, perhaps, of vomiting, which may be less marked than in other forms of acute obstruction), and may end rapidly in death. But the point which is likely to be distinctive of volvulus is the urgent distension of the abdomen, often due to one or more huge coils of large intestine. The diagnosis may perhaps be facilitated by the use of enemata. Mr. Treves has suggested that the passage of the hand under an anæsthetic into the rectum might clear up the case; but the attachment of the meso-rectum is often so short as to prevent the hand being safely passed sufficiently high; and with regard to the same surgeon's suggestion that auscultation be practised along the colon while enemata are given, however carefully this be attempted, and however well borne by the patient, the sound of the entrance of fluid is so diffused that it is not always easy to make sure of its presence or absence in the colon.

Treatment.—While the usual palliative treatment should be enforced at once, it must be remembered that all treatment is, in acute cases of this kind, most unsatisfactory, owing to the rapid onset, the huge size of the coils, and the early stage at which inflammatory changes set in. All attempts to reduce the volvulus by abdominal section, except in the very earliest stages, are likely to be futile, and perhaps disastrous. The distended sigmoid should be exposed and its contents evacuated, if gaseous by a trocar, if fæculent by washing them away as they escape by a stream of boiled water. If the volvulus can now be thoroughly reduced the opening may be closed; if not, it should be converted into an artificial anus. And if the practitioner is not sure that the distension is sufficiently relieved, he had better perform a lumbar colotomy, the right side being chosen if the cæcum needs relief. This has been done as a primary operation with complete success in three cases.

III. Intussusception or Invagination.—This form of obstruction is most important, owing to its frequency in early life, its rapid fatality in many cases, and the number of brilliant successes which have followed insufflation and abdominal section.

Ætiology.—Intussusception is the most common variety of obstruction to which children are liable, about one-fourth of the cases on record having occurred during the first year, and more than one-half during the first seven years of life. In early life and childhood it is more frequent in males. Intussusception would appear to be brought about by some irregular peristaltic action of one part of the intestine, perhaps conjoined with inaction of another part. Sometimes it follows severe purging, diarrhœa, or violent straining, sometimes the presence of worms, or a polypoid growth, especially in the lower ileum. In a few cases it has followed movements or strain, especially during the dandling and dancing of an infant upwards and downwards in the arms.

Anatomical Characters.—In ordinary cases a transverse section will show three rings of bowel, and a longitudinal one three layers of bowel on each side. The external of these three layers is called the *intussuscipiens* or sheath, the middle the returning layer, and the innermost the entering layer, these last two, taken together, forming the *intussusceptum.* Of these layers, the outer and middle have mucous surfaces in mutual contact, and the middle and inner have serous ones thus opposed. The increase of the intussusception takes place by the entering and middle layers moving in together, and dragging in the outer one after them. Thus, while the inner bend between the entering and the middle layers remains the foremost part of the intussusception, the outer bend between the middle and outer layers is constantly changing. Between the middle and inner layers the mesentery or mesocolon or both, as the case may be, are drawn in. This fact determines, from the first, peculiarities in the shape of the intussusception; and, later on, the compression of their vessels brings about congestion, ecchymosis, swelling, and sloughing. Thus the traction on the mesentery, often considerable as the invagination increases, causes a curving of the cylinder of the intussusceptum, and to a less degree that of the sheath, towards the root of the mesentery. It also may pull the axis of the intussusceptum and its terminal orifice out of that of its sheath, and nearer the mesenteric border of the intestine, the orifice of the end of the intussusceptum becoming also, by the traction, slit-like. Intussusceptions occur much more frequently in some parts than in others. Thus, when the small intestine, especially the ileum and lower jejunum, is involved, the *enteric* variety is spoken of (30 per cent.) In the ileo-cæcal region two forms are found: (*a*) the *ileo-cæcal proper*, in which the ileum and cæcum, preceded by the valve which forms the most advanced point of the intussusceptum, pass into the colon. This variety forms 44 per cent.; it may attain great size, the valve reaching as far as the anus, and being still liable to be mistaken by careless observers for a prolapsus recti. (*b*) In the other, *ileo-colic* (8 per cent.), the lower part of the ileum is prolapsed through the ileo-cæcal valve. The *colic* variety (18 per cent.) may occur anywhere in the large intestine, but is most frequent in the descending colon and sigmoid flexure.

Symptoms.—In *acute* intussusception the onset is sudden; pain is an early symptom, and of a colicky, griping character, but not as a rule so agonising as that which may be produced by a band. Like tenderness, it may here be a guide to the site of the intussusception. Vomiting is not so urgent as in strangulation by bands or other conditions. And the same is true of constipation: this is rarely absolute; usually it is replaced by a diarrhœa, at first fæcal, then fæcal mingled with blood-stained mucus, the admixture of fæcal matter becoming less or ultimately absent altogether. Severe tenesmus and straining recur at frequent intervals; and these, with the absence of sleep, and the inability to take food, soon exhaust the strength of little patients. On examination of the abdomen, a firm, cylindrical, sausage-like swelling can be distinctly felt as the intussusception-mass in all cases of ileo-cæcal intussusception. In these cases it may traverse the right flank, the upper part of the abdomen, the left flank, and even be felt *per anum*, or seen projecting. With the above symptoms are present, to a varying degree, those of shock and peritonitis.

Under the name of *chronic intussusception* are included those cases of intussusception which have a duration of one or more months. Their extreme importance is shown in the words of Mr. Treves—that no form of intestinal obstruction offers so many difficulties in the way of its recognition, and no form has been the subject of more error in diagnosis. This form appears most frequently in adult males. Its course is most irregular. The onset is sudden only in about one-third of the cases—a point, when present, of much value in the diagnosis of this from other forms of chronic obstruction. Pain, seldom severe, may be entirely absent for long intervals, these becoming shorter as the disease advances. Vomiting is only marked in about half the cases; it is fæculent only in about 7 per cent. The action of the bowels varies greatly. As a rule they are irregular, more often with a tendency to diarrhœa than towards constipation. In about 50 per cent. a bloody discharge from the anus may be expected. Distension of the abdomen is slight, and may be absent save during attacks of temporary obstruction. A tumour is to be felt in about half the cases. The general condition is one of wasting and anæmia, the patient not infrequently dying of marasmus.

Course and Progress.—(1) *Acute.* Unless relief is obtained, the case will end fatally, within three to five days in children, from shock and exhaustion; in infants it may be in a much shorter time, or within a week or ten days in older children; in adults between the second and third week. These cases lead up to the second class of *subacute* cases, in which life may be prolonged for three or four weeks. (2) The case may be more or less *chronic*, and terminate in death only after a period of several weeks or months, from wasting and exhaustion or peritonitis and enteritis, with or without perforation. Lastly, recovery may take place after sloughing, separation, and evacuation of the invaginated bowel. This last event, of great interest, but by no means necessarily curative, is extremely rare in children under two. It has occurred proportionately in 20 per cent. of ileo-cæcal, in 28 per cent. of colic, and in 6 per cent. of enteric cases. Its most frequent period of occurrence is from the eleventh day to the period between the third and fourth week (Leichtenstein). Briefly stated, it is brought about by adhesions forming between the invaginated and receiving portions of the bowel, and death of the intussusceptum from strangulation of its blood-supply. In most of the recorded cases it has been some portion of the small intestine that has come away; in some the cæcum and its appendix with portions of the colon. Sometimes the sloughed intestine is evacuated in shreds, at other times in its entirety. While this result is usually met with in acute cases, it may occur in chronic ones that end acutely. The signs are great fœtor of the stools, and gangrenous shreds of intestine found in them. It has been already said that this process can by no means be relied on to save life. The giving way of the adhesions, and fæcal extravasation, chronic diarrhœa, hæmorrhage, pyæmia, and, later on, a stricture, may prove fatal.

Treatment.—Acute intussusception, especially in the child or infant, demands prompt and active measures. Opium and belladonna should be given at once and sufficiently to check undue peristaltic action and relieve pain. The abdomen should be kept covered with hot fomentations; and the amount of nourishment given by the mouth should be most strictly limited. In little children especially, owing to the rapidity with which their strength runs down, and in all cases, so as to ensure a condition which still admits of replacement, reduction should be attempted as early as possible. Inflation should be preferred to injection as somewhat less risky. The child being placed fully under an anæsthetic, and its pelvis and lower limbs somewhat raised, the nozzle of a Lund's inflater, a rectal enema-tube, or a full-sized catheter well smeared with vaseline, attached by tubing to a bellows, is carefully passed into the bowel. The nates being securely pressed around the tube, air is steadily pumped into the colon, while the surgeon keeps one hand on the abdomen not only to prevent over-distension, but also to watch for any receding of the tumour towards the cæcal region. With regard to the amount of force used, replacement of the bowel can usually be effected only by considerable distension of the whole colon, and this requires a good deal of rather forcible pumping to complete it. This is especially the case with regard to the last few amounts of air sent in (Goodhart). By carefully kneading the abdomen so as to facilitate the passage of air upwards, and thus preventing the sudden over-distension of short lengths of the colon, the above risk will be still further reduced (Taylor). Inflation failing, if the condition of the patient admit of it, more powerful means may be made use of by connecting the rectal tube with an improvised water-cistern placed high above the bed, a more equable and forcible distension being thus obtained (Goodhart). This authority points out that the last method entails a greater risk of rupture of the bowel, but that the end justifies the means, considering the great danger of these cases. If the above methods fail, abdominal section should at once be resorted to in suitable cases. The following points are here important: (*a*) *The age.* In infants under a year, unless reduction is early tried and quickly successful, the prognosis is very desperate, whether an operation be performed or no. (β) *The condition of the patient as to collapse, &c.* (γ) *The duration of the case.* In the majority, especially in children, the tendency of the condition is to strangulation and not simply incarceration, and while the rapidity of the strangulation varies a good deal, the chances of inflation or injection are small, unless in recent cases. (δ) It is thus of the utmost importance to decide *whether the bowel is strangulated or incarcerated.* Mr. Hutchinson points out that the severity of the symptoms will be helpful here, namely, the urgency of the vomiting, the degree of the constipation, the character of any stools passed, and, above all, as utterly incompatible with gangrene, advance of the tumour onwards.

Only the chief points in *the operation* can be given here. The peritoneal cavity being opened by a median incision with the umbilicus for its centre, the intussusception is found. For a few minutes careful pressure should be made on this to diminish the œdema and inflammatory swelling, before any attempts at reduction are made (Senn). The wound being sufficiently enlarged so as to admit of two fingers of each hand, and the small intestine packed away, if the mass cannot be hooked up into the wound it must be reduced *in situ.* This can be done, if there are no adhesions, either by traction upwards on the upper part of the invagination; or, as thought better by Mr. Hutchinson, by finding the lower part, holding the ensheathing part so that it cannot be drawn into constricting folds, and backing out the contained bowel by gentle squeezing movements between the finger and thumb. These movements must be continued, and the finger and thumb gradually shifted upwards along the gut till every atom of the mass is reduced; this being often made known by the appearance of the vermiform appendix. Every care must be adopted to finish the operation as speedily as possible, and every precaution taken against shock. The chief points in the after-treatment are the application of warmth, and the administration of milk, brandy, and laudanum.

IV. Impaction of Gall-stones.—These may enter the intestine either after passing down the gradually dilated duct, or after a process of inflammatory adhesion and ulceration between the gall-bladder and duodenum or colon. It is in this latter way that gall-stones large enough to block its canal get into the bowel; and hence in such cases, though there is usually a previous history of more or less suffering in the hypochondriac region (which may assist in the diagnosis), those paroxysms of pain and the jaundice which accompany the passage of gall-stones down the duct may not have been experienced. Gall-stones may either escape by the anus, or become firmly impacted and completely obstruct the intestine. Obstruction from this cause is, however, comparatively rare. It is met with far more frequently in the female than in the male, and with very few exceptions after late middle life. The patients are often very obese. As a rule the obstructing gall-stone is single. The most common seat of impaction is the lower ileum, and next to this the jejunum or duodenum.

Symptoms.—These are usually sudden and acute; death from enteritis conjoined with those of acute obstruction occurring, as a rule, in about five days, perhaps earlier, as the result of shock. Recovery rarely takes place. In some few exceptional cases relief has come about even after periods of severest suffering, by the release and onward passage of the stone; in some the bowel has become stretched into a kind of diverticulum, in which the stone has remained lodged; in some, after adhesion and ulceration, an opening has been formed between the small intestine and the neighbouring part of the colon, or by similar processes the stone has escaped externally.

Diagnosis.—This is aided by the sex, age, and previous history of the patient; the acuteness of the symptoms; and perhaps by the recognition of a more or less distinct hard lump corresponding to the obstructing gall-stone.

Treatment.—If a very short trial of palliative treatment is futile, abdominal section is here the patient's only chance; though, owing to the usual age, habits, and condition of the tissues, the step must always be a very anxious one. The stone having been found, it may be dealt with—(1) By trying to pass it on into the large bowel. (2) By intra-intestinal crushing, either between the fingers or by flat-bladed forceps guarded with indiarubber tube. (3) This may be facilitated by Mr. Tait's suggestion of puncturing the stone with a needle, passed obliquely. (5) The loop being drawn outside, the stone may be extracted and the opening most carefully closed.

V. Contractions.—In this class may be included cases due to adhesions, kinking or compressing the gut, or matting together several coils; and those where mischief, inflammatory or malignant, has closed the lumen by traction, or narrowed it—as when the mesentery puckers from old inflammatory or malignant mischief. These cases are amongst the gravest and the most hopeless of intestinal obstructions; they affect the small more frequently than the large intestine; and are often preceded by old peritonitis.

Symptoms.—Owing to the rarity of stricture of the small intestine, this group practically comprises all cases of chronic obstruction of that part of the bowel (Fagge). The attacks are often repeated, and the final one is in duration subacute or chronic rather than acute. Thus, sickness or constipation will not be severe, however high up the obstruction may be; severe collapse or suppression of urine will probably not appear. On the other hand, visible peristalsis, and attacks of pain with loud rumblings, will probably be marked features.

Treatment.—This must be mainly palliative, on the lines already laid down. Abdominal section is here especially likely to be disappointing, owing to the complicated nature of the obstructing agency, the fact that it is often not very localised, and the intimacy with which it is blended with one or more coils of intestine, or with these and some other viscus as well. Formation of an artificial anus, and still more colotomy where the large intestine is affected, may give relief.

VI. Obstruction from Stricture.—(*a*) *Simple cicatricial stenoses.* These may result from the effects of dysenteric, tubercular, or syphilitic ulceration of considerable extent. The dysenteric are most frequent in the lower part of the large intestine, the tubercular in the lower ileum and about the ileo-cæcal valve, and the syphilitic in the rectum. Rarer instances of stenoses occur after injury, the strangling of an intussusception, the strangulation of hernia, or the ulceration produced by temporarily impacted gall-stones, fæcal masses, or foreign bodies.

(*b*) *New-growths.*—A more exact pathology has practically narrowed down these to one kind, namely, cylindrical epithelioma. Very rarely innocent growths—*e.g.* fibromata or adenomata—may cause more or less obstruction, usually by becoming polypoid. The locality attacked is in the very great majority of cases on the left side. Most cases occur in about equal proportions in the rectum and sigmoid flexure; then about half as frequently in the left colon and splenic flexure; the remainder being met with in the ascending colon and hepatic flexure.

Symptoms.—In the earlier stages these are often by no means marked. Disordered, irregular, and unsatisfactory action of the bowels, and general discomfort, with intervals of comparative ease, constitute the earliest indications. At this time, owing to the forgetting or deferring of an examination, the cases are far too frequently treated as instances of flatulence, indigestion, and constipation. Later on, the symptoms of obstruction become more pronounced. In most cases abdominal distension, accompanied by fœtid eructations and pain, comes on, varying in degree from time to time. The pain is usually distinguished by its paroxysmal character, and its relation to unwise feeding. Vomiting usually appears late, until then being replaced by nausea, and usually only becomes fæculent in the final attack of obstruction. The motions are always unsatisfactory, the bowels not acting without aperients, loose stools often alternating with scybala, or broken up bits with slime and mucus coming away. Troublesome, teasing tenesmus, causing the patient to repeatedly seek relief from the sensations of an imperfectly emptied bowel, is often present when the stricture is low down. Peristaltic movements of the intestines, accompanied by colicky pain and rumbling borborygmi, become increasingly frequent and manifest as the muscular fibre hypertrophies. As the case progresses, the general condition of the patient, with the increasing emaciation and cachexia, and the failure of treatment, all point to the malignant aspect of the case.

Course and Terminations.—The course of all such cases, though very variable in duration, is progressively unfavourable, and sooner or later death supervenes, usually from peritonitis, with or without perforation, or from exhaustion by prolonged suffering and possibly suppuration. Absolute occlusion, as a rule, comes about slowly. In some cases it is never completely established; in others, it occurs suddenly, from impaction of hardened fæces or undigested food. It is worthy of note that, even in cases in which the seat of constriction is in the sigmoid flexure or rectum, the greatest evidence of stress of the fæcal accumulation, distension, ulceration, and perforation, is often in the cæcum.

Treatment.—From the very first, as soon as there is reason to suspect the presence of a stricture, the most careful attention to diet, and the regular administration of such medicines as will favour soft, semi-solid motions, should be insisted on. If these points are attended to, the patients may be kept, for the year or two which the disease takes to run its course, in comparative ease; but it is extraordinary how frequently and at what cost these most obvious precautions are still neglected. Patients, the subjects of stricture, should be warned that they are living on the brink of a precipice. As a rule, carelessness in diet brings its own penalty, and most patients willingly acknowledge the relief which such a diet as the following gives. Soups; milk, bread and milk, milk and oatmeal, arrowroot; poached or whipped-up eggs, a few oysters, a little vegetable (especially those which leave a small residue) with plenty of gravy, or well puréed with milk; a little underdone meat, well pounded or shredded. In the early stages, and later on in the intervals of relief from threatening obstruction, laxatives should be given regularly. Thus cascara sagrada tablets, compound liquorice powder, a pill containing aloes, compound extract of colocynth and oil of juniper —one of these may be administered overnight, while Hunyadi Jànos, or a similar water, is given in the morning. In other cases castor oil is preferable, or strychnine, belladonna, and aloes may be given in the form of pill twice or three times a day. Where obstruction is actually threatening, a laxative such as castor oil or sulphate of magnesium may still give great relief if combined with a little tincture of opium, and aided by enemata of castor oil. But where obstruction is actually present, the case must be treated on the usual lines, a sedative here replacing laxative treatment.

When the above treatment has failed, lumbar colotomy (on the right or left side, according to the indications afforded) should not be too long deferred. The merits of this operation in relieving suffering and prolonging life in such cases can scarcely be esteemed too highly.

VII. Obstruction from Compression from without.—Various viscera, enlarged and displaced, especially the uterus and ovaries, and in rarer instances the spleen, the kidney, or even a distended bladder; tuberculous or cancerous glands, tumours of the omentum, growths from one part or other of the abdominal or pelvic parietes, hydatid cysts, &c., may so compress a neighbouring portion of bowel as to lead to obstruction.

Diagnosis.—Careful examination, including that *per vaginam* and *per anum* (sometimes the introduction of the hand into the rectum may be useful), together with the history of the case, consideration of the collateral signs and symptoms, and in some cases, as where the swelling is cystic, an exploratory tapping or aspiration, will generally suffice to establish, approximately at any rate, the existence of this form of obstruction.

Treatment.—This consists, first, in the removal of the cause, if practicable; secondly, where this is impossible, in relieving the obstruction. By altering the position of the body, the displaced viscera may sometimes be moved so as no longer to compress the bowel; tumours—ovarian, uterine, renal, or hydatid—may be dealt with by operation. Where this is impossible, manipulation or copious enemata may be employed, or sedatives may be tried, in the hope that the bowel may, under their influence, release itself. But if none of these measures should be applicable or successful, and if the symptoms of obstruction be severe, resort to colotomy, or the making of an artificial anus by abdominal section, may become needful. In some cases of this class more especially, relief has been afforded by puncture with a fine trocar and cannula.

VIII. Obstruction from Impaction of Foreign Bodies, Intestinal Concretions (Enteroliths), &c.

(*a*) Foreign bodies in bulk, such as bones, coins, &c., occasionally find their way into the intestines. In a considerable proportion of cases they are evacuated *per anum* without much inconvenience; in some cases they give rise to enteritis and various other intestinal troubles; in some rare cases they lead to more or less complete occlusion, with acute or subacute symptoms.

(*b*) Foreign bodies, as hair, &c.; skins, seeds, and stones of fruit (the husks of cereals, and oats especially), the curds of milk in young children, and some medicinal substances, as magnesia, chalk, iron oxide, &c., taken over a long interval, may accumulate and give rise to more or less complete obstruction. Such masses constitute the large proportion of the so-called 'intestinal concretions' in the human subject.

(*c*) Hard concretions (enteroliths), consisting for the most part of phosphates of lime and magnesium, with organic material, and having usually as a nucleus some foreign body or hardened fæces, have rarely been met with.

Intestinal concretions are most frequently found in the cæcum or rectum; much more rarely in the ileum. They are slowly formed, and rarely bring about intestinal obstruction.

Treatment.—As a rule, purgatives can only do mischief. Soothing remedies give temporary relief, and favour the gradual onward passage of the foreign body. If absolute impaction has clearly taken place, and the symptoms are urgent, abdominal section and extraction may be imperative.

IX. Obstruction from Impaction of Fæces.—Prolonged constipation may lead to definite obstruction by impaction of fæcal masses, conjoined with paralysis and inaction of the bowel from distension, and contraction of the empty portion below. Sometimes the occlusion is rendered more absolute and irremediable by the doubling or dragging down of the bowel by the weight of its contents. The seat of the obstructing fæcal mass is usually the sigmoid flexure or the rectum; but great accumulation and its effects—distension, ulceration, perforation—are often most manifested in the cæcum. This cause of obstruction is most frequently met with in women of sedentary habits, after middle life, and especially amongst hypochondriacs or lunatics.

Symptoms.—These are characterised by their chronicity; complete occlusion, as a rule, coming about slowly. There is little or no actual pain during the earlier stages; and even during the later stages, in the absence of complications, it rarely becomes acute. Vomiting is altogether absent at first; in the later stages there may be much nausea, accompanied with foul evacuations, and, towards the last, fæculent vomiting. Absolute constipation is slowly established, and then may last for two or three months. In a few cases the extraordinary periods of seven, eight, or even nine months have been reached without relief (Treves). Before the constipation has thus become absolute, it has very likely been interrupted by attacks of diarrhœa, due to catarrh of the intestine above the impaction, and giving very imperfect relief. The fæcal masses can sometimes be felt on examination of the abdomen, or they may be concealed by the presence of fat, flatus, and distension.

Course.—In a considerable proportion of these cases relief may be afforded by appropriate treatment. In some, death ensues from gradual exhaustion, from peritonitis after ulceration and perforation, or from acute obstruction owing to the bowel becoming suddenly blocked or acutely kinked.

Treatment.—Very copious enemata, administered through a long soft tube, are especially useful, the rectum being first cleared out with a finger or spoon. Such enemata, consisting of thin gruel, soap and water, with turpentine, castor oil, or ox-gall added, should be repeated from time to time, and carefully insinuated onwards as far as practicable. Or a stream of warm water from a vessel raised to a height through a long tube, may be advantageously made to play upon and wash away, portion by portion, the fæcal mass (Gay). In some cases galvanism and massage, aided by the sudden application of heat and cold, may be useful.

In the earlier stages, laxatives or purgatives may be given with safety and advantage. A teaspoonful of Rochelle salt in a cupful of mutton-broth is an old but often efficacious remedy. In the later stages, and when purgatives alone are contra-indicated, they may be combined with sedatives, castor oil or sulphate of magnesium being given with small doses of laudanum, or calomel being similarly combined with a little Dover's powder. The use of belladonna in large doses is often peculiarly beneficial.

In the extremest cases, while colotomy is to be looked on as the very last resort, the practitioner should avail himself of this rather than allow his patient to die of over-distension and ulceration of the intestine. When relief has been obtained, the greatest care as to diet and after-management is necessary, in order to prevent that recurrence of trouble to which the patient remains liable. *See* Constipation.

X. Obstruction from Congenital Malformation.—Constriction or occlusion of this kind is very rarely met with in the duodenum at or about the entrance of the common bile-duct, or about the junction of the duodenum with the jejunum; and in some cases has appeared to depend upon valve-like folds of mucous membrane, resembling enlarged or confluent valvulæ conniventes. The lower portion of the ileum, near the ileo-cæcal valve, or about the junction with the omphalo-mesenteric duct, appears most likely to be so affected. The colon (and almost exclusively the sigmoid flexure) is the part of the bowel most frequently constricted by the effects of fœtal peritonitis, but instances are very rare.

All such cases are of pathological interest rather than of practical importance. Vomiting of meconium, absence of proper evacuation, straining, convulsions, and evidence of more or less severe suffering, are followed by speedy death, though in some rare instances life has been prolonged for weeks or even months. No treatment can avail, and surgical operations can only hasten death, or at best succeed in prolonging misery.

Very much more common, and somewhat more hopeful, are those cases in which there is congenital defect of the lower part of the rectum or anus, or both. They may be divided into—(*a*) imperforate anus; (*b*) anus in natural position, but the rectum deficient.

Treatment.—Immediate relief may often be afforded by surgical operations, and in some instances more or less permanent good results have been obtained, and by persevering management maintained; but survival to adolescence or adult age has seldom ensued. *See* Rectum, Diseases of.

Arthur E. Durham.
W. H. A. Jacobson.

INTESTINAL WORMS.—This combined term was formerly much employed in medical literature, as an equivalent for the simpler expression *entozoa*, which latter title is far better, more comprehensive, and now in general use. To be sure, nearly all the internal parasites of man, at some time or other during the course of their development, play the part of *intestinal* worms, within either the human or animal host; but since this particular residence frequently constitutes neither the only locality they occupy, nor the principal feature of their life-record, it is well that the misleading words in question should be altogether abandoned from medical science. *See* Entozoa; and Parasites. T. S. Cobbold.

INTESTINES, Diseases of.—Synon.: Fr. *Maladies de l'Intestine*; Ger. *Krankheiten des Darmes.*

General Remarks.—Morbid affections of the intestinal tract are of very frequent occurrence at all ages.

The direct exposure which this canal offers to external influences, in the form of ingesta, will account for a large proportion of cases; so many irritants can exert their immediate influence, and produce what may be termed *primary* affections of the canal. On the other hand, since much of the physiological work of the tract depends for its performance on a healthy condition of other functions, especially those of the blood-circulation and nervous system, any disturbances of these processes will tend to influence injuriously intestinal digestion, and thus give rise to *secondary* diseases of the bowel. And it is evident that an improper preparation of the food in the intestine must in its turn affect the nutrition of the tissues generally, and among others those of the canal itself.

Due to these varied causes are the most diverse forms of structural disease, implicating especially the mucosa and submucosa, and less frequently the muscular and peritoneal coats. Perversions of vascularity, such as hyperæmia and congestion with their results, hæmorrhage and œdema, are often met with; and all degrees of inflammation, from a simple catarrh to suppurative enteritis with abscess, or diphtheritic and other specific forms of disease, such as typhoid, dysenteric, and choleraic. Among the forms of degeneration the lardaceous is the most important; of new-growths, carcinoma is most common, with tubercular next, whilst the connective tissue, fatty, mucous, and vascular neoplasms are rarer; malformations and malpositions complete the list of structural affections. *See* Digestive Organs, Diseases of.

Although structurally continuous with the stomach, and closely associated with it in its working, the intestine nevertheless is exceedingly prone to be diseased independently of that organ, while at other times both suffer together. Certain regions of the tract favour the development of disease, and it is rare to find the entire length of the canal involved; whilst one portion of the tube, the jejunum, is probably less liable to disease than any other organ of the body.

Thus it is that the symptoms due to a disease of the intestines may be masked by more prominent signs of mischief elsewhere, though secondary to the intestinal affection; whilst in other cases the disease we have to treat is but an expression on the part of the bowels of a morbid state, primarily connected with some other organ.

It must be remembered that many symptoms referred to the intestines are really due to improper digestion in the canal induced by causes remote from the bowels, which may be practically normal. Such conditions are to be distinguished from structural affections of the tissues of the intestines, which are mainly the subject-matter of this article, the functional perversions being treated of in the article, Digestion, Disorders of.

The indications of actual intestinal disease are frequently vague and uncertain. The subjective symptoms, such as pain, may be completely wanting in some of the most serious forms of disease, or out of all proportion to the severity of the case. An ulcer may proceed to perforation with but a minimum of discomfort, whilst an attack of simple colic may be agonising. Nor is physical examination so fruitful in its results in the case of intestinal disease as it is in the affections of many other organs, though perhaps in no other region is the *tactus eruditus* so valuable. Many of the states to be considered here undoubtedly pass through their whole course without giving the slightest indication that can be recognised by physical examination. An investigation of the evacuations at present furnishes information within the narrowest limits. From all these circumstances, a diagnosis of many diseases of the intestines must be almost a matter of inference and conjecture.

In respect to treatment, very much may be done with the means at our command. The removal of causes is in a large proportion of cases easy, and a complete cure may be effected. And whilst some of the remaining cases admit of little or no relief, a greater number can be partially alleviated by suitable remedies.

The several diseased conditions of the intestines will be discussed in the following alphabetical order:—(1) Abscess; (2) Albuminoid disease; (3) Atrophy; (4) Concretions in; (5) Contraction; (6) Dilatation; (7) Gangrene; (8) Hæmorrhage; (9) Hyperæmia and Congestion; (10) Hypertrophy; (11) Inflammation, Acute and Chronic; (12) Malformations; (13) Malignant disease; (14) Malpositions; (15) Micro-organisms; (16) Morbid growths, Non-Malignant; (17) Paralysis; (18) Parasites; (19) Perforation and Rupture; (20) Spasm; (21) Syphilitic disease; (22) Tubercular disease; and (23) Ulceration.

1. Intestines, Abscess in Walls of.—In the course of severe cases of enteritis—phlegmonous—where the inflammatory process affects all the coats of the bowel, and the products infiltrate the different tissues, collections of pus may be found, but with no well-defined limit, such as constitute an abscess. Such collections may open into the intestine, leaving small ulcers; or through the peritoneal coat, and so cause perforation.

In the chronic enteritis met with in scrofulous subjects, the solitary and agminated glands may undergo slow suppuration, and form abscesses which end by opening into the bowel.

Such morbid products are rather of *post-mortem* interest, giving rise to no special symptoms during life which will permit of their being diagnosed, apart from the existing enteritis; and they are incapable of special treatment.

2. Intestines, Albuminoid Disease of. The intestines appear to be affected with lardaceous disease next in frequency to the spleen, liver, kidneys, and lymphatic glands, and it is rare for the alimentary canal to show signs of this degeneration until it has become far advanced in the above-named organs. It is stated that the intestines are affected in 42 per cent. of all cases (Habershon).

Anatomical Characters.—As in other organs, the inner coat of the arteries, particularly of those surrounding the solitary and agminated glands, appears to be the starting point of the albuminoid change, from which it gradually extends to adjacent tissues, until the whole thickness of the bowel may be replaced by this material. In milder cases it is limited to the mucous and submucous coats, which in all cases are the first to suffer, the villi being specially affected. Considering the exceeding proneness of the Malpighian corpuscles of the spleen to undergo this change, it is noticeable that the solitary and agminated glands of the intestine, which are of similar structure, should long resist the degeneration, and in many cases may be quite unaffected. Sooner or later, however, the albuminoid granules appear in these structures, until the whole gland is involved. The mesenteric glands are usually implicated; and in severe cases the mesenteric and peritoneal vessels, and even the appendices epiploicæ (Hayem).

To the naked eye the mucous membrane appears smooth, pale, and thickened, often of a 'peculiar glistening aspect' (Friedreich), resembling wet wash-leather (Moxon). The pallor is very striking. When the degeneration is extreme, the surface ulcerates, especially over the follicles, from fatty degeneration and breaking down of the new material, the diminished blood-supply by the constricted vessels leading to this result.

The small intestine, and particularly the lower part of the ileum, is the usual seat of the disease, which sometimes extends upwards to the duodenum and stomach; the colon is occasionally affected.

Symptoms.—The most prominent symptoms which this condition gives rise to, so far as the alimentary canal is concerned, are diarrhœa and hæmorrhage. Since the other important viscera are always simultaneously affected, other symptoms coexist. The diarrhœa is rather characterised by fluidity than undue frequency of the stools, though the latter does occur; the evacuations are often greenish from altered blood. It is rare to find either pain or tenderness; and the diarrhœa when once established rarely ceases.

Hæmorrhage from the surface of the mucous membrane, independently of any ulceration, may occur from rupture of the diseased vessels.

Treatment. — Enemata of starch and opium are useful, though their effect is but temporary. Recovery, even from an advanced state, may follow if the cause, such as a suppurating joint, can be completely removed.

3. Intestines, Atrophy of.—A general atrophy of the intestines accompanies a wasting of the entire body from any serious cause of malnutrition, such as starvation, where the organs are estimated in fatal cases to lose

42 per cent. of their weight, becoming extremely thin and transparent.

Intestinal catarrh may lead to atrophy of the bowels, even to an extreme degree. Nothnagel, who has specially studied this condition, found evidence of it in 80 per cent. of deaths from all causes, and at all ages, even six weeks after birth. It may follow on a catarrh which is acute—this being frequent in children—or on the sub-acute or chronic forms. Certain parts of the canal are more liable to be affected than others, the cæcum, ascending colon, and lower end of ileum being the regions most commonly attacked. The change is almost restricted to the mucosa, the villi of the small intestine especially suffering, the thickness of the coat being reduced to one-fifth the normal in extreme cases, together with complete disappearance of Lieberkuhn's glands. The entire layer is replaced by connective tissue containing a few round cells, and presents a smooth appearance, with irregular thickenings at places; there is none of the pigmentation so constantly seen in the fibroid change of chronic catarrh; the muscular tissue, even of the mucosa, and the lymphoid follicles are unaffected. Nothnagel has also described areas of the muscular coat congenitally atrophied.

The symptoms referable to this condition, when the small intestine is involved, are those of general malnutrition from deficient absorption of the digested foods, and this may be so severe as to prove fatal, especially in children and infants. When the change is limited to the colon, there may be nothing beyond a slight diarrhœa, with bulky pultaceous offensive stools free from mucus. No treatment is specially available for this condition.

4. **Intestines, Casts of.**—*See* Casts.

5. **Intestines, Catarrh of.**—*See* 13. Inflammation.

6. **Intestines, Concretions in.**—Synon.: *Enteroliths.*—These are commonly met with in the colon, cæcum, and appendix, which offer greater facilities of lodgment, and are liable to cause enteritis, ulceration, and perforation, or varying degrees of obstruction. *See* Calculi; and Intestinal Obstruction, p. 1010.

7. **Intestines, Contraction of.**—The calibre of the intestinal canal may be diminished by the pressure of tumours; by structural changes in the walls, such as cicatrices; or by displacements of portions of the bowel in invagination, &c. Such causes of stricture are more properly described under intestinal obstructions. *See* Intestinal Obstruction.

The term 'contraction' may be applied to that state of shrinking which the gut is liable to present below the seat of any permanent stricture.

Congenital malformations, producing contraction of the canal, even to complete occlusion, may be met with.

8. **Intestines, Dilatation of.**—The normal diameter of the small intestine may be taken as 1½ inch throughout; and that of the large intestine as gradually diminishing from 2½ inches at the cæcum, to 1½ inch at the upper part of the rectum. But the canal is evidently capable of distension much beyond these limits, as may be recognised when large accumulations of flatus or fæces occur. Such conditions, however, may disappear after death, the bowel returning to its proper capacity. These dilatations, therefore, may be regarded as temporary.

Other forms of distension of a more permanent nature are frequently observed.

Cases have been recorded where extreme distension of the bowel, with considerable hypertrophy of the muscular coat, occurred without any obvious cause, but associated with marked constipation. These have been provisionally termed *idiopathic*, and compared to similar affections of the œsophagus and stomach. The condition has been met with in children even at birth, as well as in adults, and usually runs an acute and fatal course. In one case the colon was uniformly distended to a diameter of 6 to 8 inches; and in another the average diameter of the small intestine was twice the normal, the stomach also sharing in the distension; the person had been a large eater, and was extremely fat. The sigmoid flexure appears to be very prone to this distension.

In the greater number of cases the dilatation is attributable to the existence of some stricture in the course of the canal, and inasmuch as a persistent obstruction is usually located somewhere in the large intestine, it is the colon which most frequently suffers, and this may be so excessive as practically to obliterate the ileo-cæcal valve. The mere accumulation and retention of the contents above the obstruction is doubtless one factor in causing the distension; but a diminished resisting power on the part of the gut probably co-exists, brought about by malnutrition of its textures. The muscular coat of the dilated portions is usually hypertrophied, while the mucous membrane is thinned and peculiarly liable to ulceration, the decomposing contents furnishing an exciting cause for this result.

Localised bulgings or sacculations of the bowel may be met with, sometimes involving all the coats, and occasionally as diverticula formed by protrusions of the mucous membrane between the muscular fibres covered only by peritoneum. These 'false or distension diverticula' are commonly found in old people suffering from chronic constipation or some condition causing general distension of the intestines; they are single or multiple, occasionally occurring in great numbers and globular in shape; are most frequent in the colon, where they extend into the appendices epiploicæ, and occur less often in the small intestine along the mesenteric border. Inflammation from the irritation of fæcal or foreign matter is liable to be set up in them, leading to perforation into the peritoneum, or very rarely to communication with the bladder.

The existence of any extreme dilatation may be recognised by inspection or manipulation of the abdomen, especially if the parietes be thin and wasted, as they frequently are in such cases. Tympanites is present to a variable degree, uniformly distending the abdomen or causing asymmetrical swelling. Fæcal vomiting may occur in connexion with the existence of a dilated intestine, but this is rather to be attributed to the primary obstructing cause, in the symptoms of which the few indications peculiar to this condition are merged. In extreme cases, the movements of the diaphragm may be interfered with, and the heart's action impaired even fatally.

Paralysis or atony from wasting or degeneration of the muscular coats, by diminishing the resistance of the bowel, allows of its distension. This is well exemplified in the extreme dilatation from flatus which so frequently accompanies acute peritonitis; and is comparable to certain cases of gastro-ectasis of a temporary character.

9. Intestines, Gangrene of.

Ætiology.—The immediate cause of the absolute death of a portion of the intestine is the complete arrest of the flow of blood through the part affected. This obstruction may be produced by:—

(i.) Embolus of the superior mesenteric artery. Several cases of this condition have been recorded.

(ii.) Thrombus of the mesenteric veins. The perfect stasis induced by this cause is of very rare occurrence, but it has been seen to follow invasion of the portal vein by malignant disease, and associated with thrombosis of the femoral vein in the puerperal state.

(iii.) Detachment of the mesentery close to the intestine will be followed by gangrene of the part which is thus deprived of its blood-supply.

(iv.) Local constrictions of the bowel. This is by far the commonest class of causes of gangrene, and is the probable sequence of an unreduced strangulated hernia, an invagination or ileus. In these states the vessels are pressed upon, owing to the altered position of the gut, which, with the continuously increasing pressure of the œdema that follows the venous obstruction, leads to complete stasis.

(v.) The more gradual obstruction to the blood-flow, from constriction of the vessels by diseases of their walls, leads to sloughing, and tends to occur in lardaceous disease of the intestines.

(vi.) Sloughing also occurs as a sequence of the long-continued pressure of hard fæces, or of the inflammatory state, when the process is of such intensity that complete cessation of the circulation takes place in localised spots, usually affecting the mucous membrane only, though occasionally penetrating deeper, ulcers remaining after separation of the sloughs.

Anatomical Characters. — From the nature of the constructive tissues of the intestine, the gangrene which is met with is of the moist variety. The portion of bowel which is affected is at first of an intense red colour, gradually increasing to purple, and even to black. The extreme congestion of the vessels leads to effusion of blood into the tissues, which are uniformly coloured; decomposition rapidly takes place in the stagnant blood, and the products acted on by the sulphuretted hydrogen of the intestines become black, all traces of red colour being soon lost. Meanwhile the mucous membrane and muscular coats are swollen and sodden by the serum and blood with which they are infiltrated, and a dark, black to ash-grey, soft, pulpy mass is finally thrown off from the healthy tissue. The extent of substance which may undergo this necrosis and be separated is extremely variable, from a mere slough of half an inch in diameter or smaller, to portions of bowel several feet in length. The late Dr. Peacock records a case where twelve feet were passed in eight portions during a period of three years.

Symptoms.—The occurrence of symptoms whereby mortification of the bowels can be diagnosed is scarcely to be expected. The signs for the most part resolve themselves into those of the cause, whether that be a plugging of the mesenteric vessels, or a localised enteritis. Extreme fœtor of the stools may suggest its presence, but can afford no indication of the extent or depth of bowel involved, which are all important data for prognosis, and to some degree for treatment. It is not until the sphacelus has been passed *per anum*, or that signs of ulceration are manifest, that the positive existence of gangrene can be ascertained. A very few hours suffice to produce this condition when once the cause is established; and since it cannot be either arrested or cured, the separation of the slough is to be desired, although fatal hæmorrhage or perforation may be associated with this process. Intestinal gangrene is always to be regarded as grave; though recovery not infrequently follows sloughing of considerable tracts when confined to the mucous membrane.

Treatment.—The circumstances associated with this morbid process as a rule preclude any treatment being specially directed towards it. If there be reason to believe that the entire thickness of the intestine is gangrenous, operative proceedings should be at once resorted to. Considerable success—even 50 per cent. of recoveries according to some—has followed resection of the dead part of the bowel, and union of the segments by sutures (*enterorraphy*).

10. Intestines, Hæmorrhage from.—An escape of blood from the intestines is a sign of certain morbid conditions rather than an actual disease itself, hence the cause of the hæmorrhage must be sought for.

Ætiology.—The causes of intestinal hæmorrhage may be thus indicated:—

(*a*) *Increased blood-pressure*: Intense hyperæmia or extreme congestion from heart-disease, portal obstruction, embolism or thrombosis of the mesenteric vessels, intussusception, &c.

(*β*) *Affections of the intestinal walls*: Injuries of the bowels; ulceration; vascular growths, hæmorrhoids; lardaceous disease of the walls.

(*γ*) *Primarily altered blood-states or deterioration of vessels*: Purpura hæmorrhagica; scurvy; leucocythæmia; yellow fever and severe intermittent and remittent fevers; hæmophilia.

(*δ*) *Occasional causes*: Disease of the stomach; rupture of aneurysm into intestine; vicarious menstruation.

The mere enumeration of the causes must here suffice. It is obvious that the relative frequency of these conditions differs considerably, and in many cases the cause is at once apparent, whilst occasionally the source of the blood may be more obscure. It would seem from statistics that intestinal hæmorrhage is of more frequent occurrence in males, as gastric hæmorrhage is more common in women; the latter fact being explained by the greater liability of females to ulcer of the stomach, as the former appears to be by the preponderance of males suffering from the determining causes of hæmorrhage, such as liver-disease.

Symptoms.—Associated with the symptoms special to the loss of blood, and which are in the main similar to bleeding from any other organ, there are the signs and symptoms of the causal disease. The extent of the hæmorrhage will necessarily largely determine the symptoms, many bleedings being so trivial as to give rise to no appreciable effects, and in extreme cases the loss being so great and sudden as to lead to rapid collapse and death. Between these extremes all degrees of anæmia, faintness, pallor, giddiness, and failing pulse may be observed. A sensation as of a warm fluid flowing into the abdomen is occasionally complained of, but otherwise hæmorrhage in this situation is seldom possessed of characteristic features. Abdominal pain may accompany intestinal hæmorrhage, and is specially severe in embolus of the mesenteric arteries, but this symptom is not to be attributed to the bleeding, both being associated manifestations of a common cause. The occurrence of the above mentioned indications in the course of a disease liable to lead to this condition, would point to hæmorrhage, especially if there be a fall in temperature from a previous pyrexial state.

Occasionally the escape of blood is beneficial. This is particularly the case where the cause is a congestion of the intestinal tract, with or without hæmorrhoids. Thereby the fulness of the bowels is relieved, and a more equable circulation is established. In some cases of typhoid fever, contrary to what might be supposed, improvement has been noticed to follow a moderate loss of blood (Trousseau).

Except in such cases as when the effusion of blood is so excessive that death takes place before any escapes from the bowel, intestinal hæmorrhage reveals itself sooner or later in the character of the evacuations. If the cause be situated immediately within the anus, or the blood be sufficient in amount to escape alteration, then the red colour is retained. The hæmatin is readily affected by the sulphuretted hydrogen in the canal, and converted into a blackened material, sulphide of iron being formed, which stains the fæces; or a black tarry substance is evacuated, being the altered clotted blood (*see* Melæna). As a rule, when the blood has undergone this change, the source of it is in the stomach or small intestine; blood from the colon—where it is usually due to ulceration—being passed adherent to the fæces. The height of the source, the quantity, and the duration of its stay in the canal, largely determine the extent of alteration in the blood, and its degree of admixture with the fæces.

Diagnosis.—The history of the case; the condition of the patient; and the character of the voided blood (*see* Melæna; and Stools), are the points upon which a diagnosis of the cause of intestinal hæmorrhage is to be based.

Prognosis.—The amount of blood evacuated is not a sure guide to forming an opinion of the result. It is difficult to estimate the actual quantity lost, since much may be retained in the bowel. The general condition of the patient, especially the state of the pulse, is of far more importance; whilst allowance must be made for the nature of the cause, not forgetting the occasional favourable import of a flux.

Treatment.—In a certain number of cases bleeding from the bowel is uncontrollable; in others it is capable of cure; whilst in a third group it is rather to be encouraged. When arrest of the hæmorrhage is desired, rest, both general and local, is essential; the patient should be maintained in the recumbent position, as thereby the liability to syncope is averted; and the canal is to be kept quiet by abstinence from food, and the free use of opium, to prevent peristalsis.

The active treatment is to be directed to withdrawing the blood as much as possible from the affected region, by means of heat, sinapisms, dry-cupping, &c.; and to the application of styptics to the bleeding surface, or the administration of such remedies as arrest bleeding after their absorption into the blood. The most effective agents given by the mouth are turpentine in a full dose of 40 to 60 drops, followed by half-drachm doses every three hours; and the pilula plumbi cum opio (B.P.) gr. v., every four or six hours. Tannic acid and the vegetable astringents are usually too slow in their action to be of much avail. Bitartrate of potassium in two-drachm doses is of much benefit in arresting the bleeding of piles; for which purpose also, as well as for vicarious hæmorrhage, or the flux of passive congestion from the lower bowel, the writer has found frequently repeated doses (♏ v. to ♏ viii.) of tincture of hamamelis most efficacious. The liquid extract of coca in doses of one and a half drachms at intervals of a few hours, for three or four doses, has been recommended for the same purpose. Probably the most reliable remedy is ergotin in two-grain doses administered subcutaneously, and repeated if needful. Should the source of the hæmorrhage be within the range of local application by rectal injections, the most useful agents for this purpose are turpentine one to three drachms, with four to eight ounces of mucilage of starch; equal parts of tincture of perchloride of iron and water; or tincture of hamamelis, a drachm to three ounces, as an enema. Such astringents as tannic acid, opium, or hamamelin may be conveniently administered in the form of suppositories.

When the hæmorrhage is distinctly the result of engorged vessels, its occurrence should not be checked, provided it be not excessive. Sulphate of magnesium in full doses, with a few minims of diluted sulphuric acid, is then of great service.

The giving of stimulants is a procedure that involves careful judgment. Whilst undoubtedly the tendency of loss of blood is to produce death by syncope, it is also true that faintness itself favours the cessation of the bleeding, and, so far as a general direction can be given, stimulants should be avoided, unless there be reason to fear, from the condition of the patient, character of the pulse, &c., that the syncope is grave. Short of that, alcohol, by temporarily increasing the heart's power, increases the bleeding.

Transfusion of blood, when practicable, should be resorted to in extreme cases. *See* TRANSFUSION.

11. Intestines, Hyperæmia and Congestion of.—The former term is here applied to those conditions of vascular engorgement where the excess of blood is, primarily at least, on the arterial side of the capillaries (active congestion, fluxion, determination of blood); whilst the latter term is restricted to cases where the fulness is caused by some obstruction to the venous flow (passive congestion). Doubtless either of these conditions may lead to the establishment of the other, but it is desirable to consider them separately, not so much for the difference in the causes producing them, as for the great difference in their results.

It should be remembered that even within the limits of health a considerable variation is met with in the degree of vascularity of the alimentary canal. The fluctuating periods of activity and rest undergone by the tube are associated of necessity with alternations of comparative hyperæmia and anæmia, as during the digestion of a meal or during fasting. It is impossible, therefore, to draw any line beyond which the vascular fulness can be said to be abnormal; as it is equally impossible to say exactly where hyperæmia and normal gland-change end, and catarrh begins. These states, on the border-line between health and disease, stop short of producing recognisable tissue-change, and are of transient duration. *See* DIGESTIVE ORGANS, Diseases of; I. Affections of the Vascular State.

ANATOMICAL CHARACTERS.—The appearances seen *post mortem* are far from being always indicative of what existed during life. For an extreme arterial fulness may completely disappear after death, from contraction of the vessels; whilst venous engorgement more or less completely remains.

ÆTIOLOGY.—The causes of intestinal *hyperæmia* are as follows: (*a*) Mechanical and chemical irritants, foreign bodies, and poisonous drugs. Spices and highly seasoned food, and alcohol; any substance, in fact, which may be swallowed, and at all exceeds the blandest nature, may bring about an abnormal degree of hyperæmia of the whole or part of the canal. These causes act locally and directly upon the vessels.

(β) Vaso-motor paralysis of the splanchnic area. If from any cause the normal tone of the mesenteric vessels is diminished, by inhibition or removal of the tonic influence excited by the sympathetic, the vessels dilate and hyperæmia ensues. It is in this way that diarrhœa following certain emotional states may be explained. The intimate relation which has been shown experimentally to exist between the splanchnic nerves and the vaso-motor system generally, but especially with the cardiac innervation by means of the 'depressor nerve,' whereby any considerable peripheral resistance in the systemic capillary area which impedes the action of the heart is compensated for by a dilatation of the mesenteric vessels, renders it probable that an undue hyperæmia of the intestines is of very frequent occurrence.

(γ) Collateral hyperæmia, or the fulness of the vessels of one region caused by contraction of the vessels of another, as in the shrinking of the cutaneous vessels from cold, extensive burns, &c. In such cases the blood, remaining constant in amount, must distend other vessels; and those of the abdominal viscera, including the intestines, are peculiarly liable to become engorged, as explained by what may be called their compensating paralysis.

(δ) Among less frequent causes of intestinal plethora are, the suppression of habitual discharges—menstrual, &c.; the removal of pressure, as of ascitic fluid; and sudden chills in hot climates.

The causes of *passive congestion* are the following: (*a*) A general congestion of the entire intestinal tract will be produced by any of those causes which lead to universal congestion of the tissues, as dilatation of the right heart from lung-disease. Pressure by tumours or other conditions on the inferior vena cava above the liver, or on the portal vein, will bring about the same result. So also will any obstruction to the portal circulation in the liver. This is by far the commonest cause of intestinal congestion, since cirrhosis of the liver, however produced, directly tends to it.

(*b*) A congestion of a portion of the tube occurs when any obstruction exists to the venous flow of that part, as is marked in cases of invagination and strangulation of the bowel.

The rarer conditions of embolism of branches of the mesenteric arteries, or thrombosis of the veins, will induce intense congestion of the region supplied by the occluded vessels. The resulting infarction is somewhat smaller than the actual extent fed by the vessels, owing to the free anastomosis at the periphery of the area. Sloughing and ulceration of the mucous membrane, or extensive gangrene of all the coats, is very liable to follow on this condition.

Both active hyperæmia and congestion are essential features of the vascular changes comprised in inflammation.

Symptoms and Effects.—These conditions may of themselves give no evidence of their existence, although an excessive and sudden hyperæmia of the splanchnic area will cause a fall in the general blood-pressure with symptoms of fainting. Overfulness, just as anæmia, of the intestinal vessels leads to increased peristalsis, probably due to the deficiency of oxygen and excess of carbonic acid which attend each of these conditions.

From hyperæmia, there is an increased secretion of mucus and other intestinal fluids, often more watery than normal, which with an increased peristalsis, induced by the same irritant that led to hyperæmia, produces a diarrhœa. Provided this over-functional activity be limited to the production of the normal secretions of the part, and increased healthy action only, the condition of hyperæmia is not exceeded; but the passage into catarrh is easy, and unmarked by any abrupt lines.

The increased blood-pressure may be sufficient to induce diapedesis of the red corpuscles, or rupture of the capillaries, leading to capillary hæmorrhage and submucous petechiæ.

As regards congestion, the more complete the obstruction to the flow, the greater will be the pressure in the veins, whose thin walls favour the transudation of the serous part of the blood, and so produce first an œdema of the mucous membrane and entire thickness of the bowel, and later an escape of fluid into the canal itself and into the peritoneal cavity, the latter being more marked. The effusion in this case is dependent entirely on mechanical conditions, with possibly some deterioration of the vessel walls; whilst the flow in hyperæmia is mainly the result of increased secreting activity. Hæmorrhage from rupture of the smaller vessels is of frequent occurrence, and may be very considerable. Profuse bleeding, often accompanied by severe abdominal pain, usually follows plugging of the mesenteric vessels.

A prolonged state of congestion—and as a rule the cause is such as to determine a permanent state—leads to certain structural alterations in the tissues of the bowel, from the imperfect nutrition that a chronic venous fulness brings about. The nature of the change is chiefly the infiltration of the mucous and submucous coats with an imperfectly formed connective tissue, often pigmented, which causes a thickening and toughness of the bowels, almost identical with the results of chronic inflammation.

Treatment.—It is seldom that these conditions are such as call for treatment. The hyperæmia is usually of a transient nature; and the cause of congestion is generally irremovable. Aperients, such as jalap and gamboge, are sometimes beneficial, by inducing watery evacuations and so relieving the vessels, but they demand constant repetition.

The treatment of hæmorrhage has been considered; but this and diarrhœa, when due to congestion, are, unless excessive, often beneficial, and are not to be checked.

12. Intestines, Hypertrophy of.—This is always of local occurrence, a general hypertrophy, involving the entire length of the bowel, being practically unknown.

In chronic enteritis the mucous, submucous, and even muscular coats are apt to become much thickened, and though this is partly due to an excessive formation of connective tissue, there is also some actual hyperplasia of the normal textures.

In portions of the intestines above an obstruction, a true hypertrophy of the gut, particularly of the muscular layers, is to be found; and, as already said, this is usually associated with dilatation of the tube. Marked hypertrophy, especially of the longitudinal muscular bands of the colon, has been noticed in those cases of so-called idiopathic dilatation where no obvious obstruction exists. The pathogeny of this condition is obscure, for it does not appear probable that it precedes the dilatation, as in the heart, but is rather developed coincidently.

It is rare for this condition to be other than inferred during life; it gives rise to no symptoms and calls for no treatment; and when established is rather of the nature of a compensatory lesion.

13. Intestines, Inflammation of.—SYNON.: Enteritis; Fr. *Entérite*; Ger. *Darmentzündung.*

Under this term are included all those structural changes in the mucous membrane of the intestinal tract which primarily follow the application of an abnormal irritant, provided that the irritant be not of sufficient intensity to produce absolute destruction of tissue. Such changes will involve more or less all the tissue-elements of the mucous membrane, and may extend to the muscular, or even the peritoneal coat. They are essentially characterised by productive, coincident with destructive features, the former leading to the formation of new material, as pus or connective tissue, the latter to ulceration or gangrene. The inflammatory process may present considerable variety in type. The simplest form, to which the term 'catarrh' may be applied, passes, by almost insensible gradations, from the tissue-changes met with in the course of normal digestion, to a distinct condition of disease. Or there may be superadded certain specific characters due either to the nature of the cause, or to the predisposition of the tissue affected, or to both, which determine the conditions known as diphtheritic, phlegmonous, dysenteric, &c. *See* INFLAMMATION.

There are thus differences in the severity with which enteritis may occur. But in all cases the essential characters of inflammation are present, which may be regarded as the results of the irritant *plus* the efforts at repair on the part of the affected tissue.

The morbid process may affect the intestine throughout its greater length, either in common with or independently of the stomach—*general enteritis*; or it may be distinctly limited to certain parts of the canal—*local enteritis*, including duodenitis, ileitis, typhlitis, colitis, and proctitis. As a rule, the term *enteritis* is restricted to inflammation of the small intestines, and it is in this sense that the disease is treated in this article.

In respect to duration and intensity, enteritis may be *acute* or *chronic.*

(*A*) **Acute Enteritis.**—Acute enteritis is sometimes called *gastric remittent*, or *infantile remittent fever*—terms it is advisable to discard entirely, since they are frequently applied to very different diseases. Acute enteritis is meant to include all those cases where the essential features of an inflammation are present, varying in severity from a simple catarrh or muco-enteritis, to those severer forms possessed of special features, such as phlegmonous or diphtheritic. The more severe cases, especially in children, are sometimes called simple or English cholera, or *cholera infantum.*

ÆTIOLOGY.—It is doubtful whether an idiopathic enteritis is ever met with; some cause is generally to be found.

Predisposing causes.—(*a*) The exposed situation of the intestinal tract to irritating substances swallowed, causes this disease to be one of frequent occurrence.

(β) The structure of the intestinal mucous membrane, with its delicate and susceptible epithelial cells, and slightly protected blood-capillaries, favours the occurrence of those changes which constitute inflammation.

(γ) Age especially predisposes to enteritis. For although it may occur at any period of life, infants and children during the period of dentition are peculiarly susceptible. A moderate intestinal catarrh may almost be regarded as a normal accompaniment of dentition, like to the increased activity of the salivary and other glands at that period. From the moderate it may easily pass into the serious or even fatal degree.

(δ) The season of the year appears to exercise an influence, for during the summer and early autumn this disease is certainly much more frequent; and particularly so when there is extreme difference between day and night temperatures, or when the heat is associated with much moisture.

(ε) Occasionally this malady would appear to be epidemic.

(ζ) Certain mental and emotional states undoubtedly confer a liability to the occurrence of symptoms which are practically indistinguishable from those of a catarrhal enteritis.

(η) Conditions of general ill-health and marasmus, especially in children, predispose to intestinal catarrh.

Exciting causes.—These, whatever their nature, would appear to act by first inducing a hyperæmia of the tissues, which thence pass into a state of inflammation.

1. Irritating ingesta of the most varied kind, such as abnormal, ill-cooked, or improperly digested food, toxic products of digestion, and irritant drugs or poisons, often cause enteritis, though not so frequently as in the corresponding affection of the stomach. Of these, improper food is by far the most common, especially during the first year of life. Cow's milk alone may be at that time sufficient to produce it, and it is rare for infants to escape an attack. An excessive flow of bile into the intestine is an occasional cause. Certain irritants, such as corrosive

sublimate, used as lotions or injections, have been known to produce enteritis—even fatal—without direct introduction into the alimentary canal.

Specific forms of intestinal inflammation are determined by various micro-organisms and their products, and to such causes may be referred cholera, dysentery, typhoid fever, and probably many cases of 'summer diarrhœa' or cholera infantum, all of which are primarily varieties of enteritis.

2. Exposure to cold may be followed by inflammation of the intestines, as it may be by inflammation of the lungs, kidneys, or pleura; what determines the particular organ involved is unknown. There would seem to be some other factor than the mere determination to the viscera of an excess of cooled blood from the contracted cutaneous capillaries, which probably affects the nutrition of the tissue-elements *viâ* the nervous system.

The occurrence of inflammation and ulceration of the duodenum which occasionally follows extensive superficial burns, cannot be altogether explained by the hyperæmia of the intestines, which is said to follow the superficial injury; but whether the cause be embolic, or the elimination by the bile of some irritant poison, is unknown.

3. Wounds, new-growths, volvulus, intussusception, herniæ, impaction of fæces, gall-stones, parasites, will lead to enteritis.

4. Inflammation of neighbouring parts may involve the intestines by extension, as from the stomach, peritoneum, or bile-ducts.

5. The specific poison of diphtheria not infrequently leads to enteritis of a characteristic nature. An inflammatory state of the intestinal mucous membrane is said to accompany or follow the exanthemata, and more especially scarlet fever; and it sometimes complicates septicæmia, particularly when this is of puerperal origin.

ANATOMICAL CHARACTERS.—It probably never occurs that the whole length of intestine is the seat of inflammation, and it is not often that even the entire small intestine is so affected. It is far more frequent to find certain tracts, of a few inches or a few feet, involved. Speaking generally, the colon, cæcum, rectum, duodenum, ileum, and jejunum are attacked, as regards frequency, in the order named. In some situations special features are present, but the essential characters of inflammation always exist, whatever be the site.

Owing to the physical properties of the intestinal tissues, and the rapid onset of softening and putrefactive changes, the appearances seen after death by no means necessarily correspond to what actually exists during life. Thus, the hyperæmic state of the mucous membrane, with the increased redness, varying from a more intense pink than normal up to a deep dark red, may leave but a trace *post mortem,* the vessels having become considerably emptied from the constriction of the vessels in *rigor mortis.* An increased vascularity, however, is one of the important features of the state under consideration, and it may sometimes be so intense as to lead to capillary rupture and formation of petechiæ in the mucous membrane. The tissue-elements of the gut, as a result of the irritant causing the inflammation, and with the accompaniment of an increased vascular supply, undergo changes in their appearance and behaviour. Thus the epithelial cells are in a state of cloudy swelling and of increased activity in multiplication, each successive progeny approaching nearer and nearer to the embryonic type; the connective-tissue elements are similarly affected; and leucocytes transude into the tissues from the vessels. These new-formed cells constitute pus-corpuscles, which are thrown off from the surface of the mucous membrane, and crowd to a variable depth the tissues of the different coats. If the primary irritant to the inflammation be of a specific character, such as the poison of diphtheria, or of an extremely severe nature, such as an intussusception or hernia, then the new-formed cells become entangled in a fibrinous, coagulable exudation from the blood, and form with the necrosed tissue-elements patches of false-membrane adherent to the surface of the bowel. In all cases there is some œdema of the intestinal walls from serous effusion, and the free surface of the membrane is covered with a glairy mucus, containing pus-cells, and frequently crystals of triple phosphate.

The epithelium of the follicles of Lieberkühn becomes extremely granular, and proliferates extensively, with the frequent result of blocking up the lumen of the gland, which thus becomes very prominent; or the tubular glands may loosen and fall out, leaving well-defined empty pits, particularly if the examination of the mucous membrane be delayed long after death. The solitary and agminated glands are invariably much swollen, and very often the process of inflammation is most intense in their vicinity. Occasionally the mesenteric glands are similarly affected.

How this inflammation may terminate very much depends on the cause and extent: it may subside, and the bowel gradually assume its normal characters with no impairment of function; it may lapse into a chronic state; or it may pass on into ulceration, or even sloughing and gangrene. *See* DIGESTIVE ORGANS, Diseases of.

To these various degrees and varieties of the inflammatory state different terms have been applied.

Catarrhal or *muco-enteritis.*—The essential characters of this are an excessive mucous secretion, with serous exudation or slight pus formation, in very variable amount, and desquamation of the epithelium. The submucosa may be infiltrated with leucocytes, but it usually remains normal, as also the muscular coat, unless the morbid condition be prolonged. Complete recovery generally takes place, but atrophy with considerable destruction of villi and Lieberkühn's glands, leaving the surface smooth and bare, not infrequently follows, especially in children. There is often some superficial erosion or simple ulceration. This form of inflammation involves great lengths of the canal, and is more common in the colon, or ileum, less so higher up.

Phlegmonous.—This term denotes a more severe form of inflammation, in which there is a more considerable formation of pus which permeates all the coats. This is a rare condition, and affects only a short distance of the bowel, which is deep red and distended, and frequently contains a sanious fluid.

Membranous enteritis.—When patches of false membrane are met with, of the nature above described, in association with diphtheria, we have a true *diphtheritic* enteritis; and the expression *pellicular* or *croupous* may be more fitly applied to those cases where a similar membrane is formed, though not in connexion with the diphtheria poison. Such a state is of not infrequent occurrence on the prominent edges of the valvulæ conniventes, and still oftener of the saccules of the colon, due to the irritation of hardened fæces or impacted calculi. Both these forms are associated with ulceration, except, it is said, in children, and affect only limited areas of the intestine.

The term *dysenteric* is very indifferently appliea to more than one form of enteritis or colitis. The writer thinks it had better be limited to that form of inflammation due to the specific poison of dysentery, although the morbid appearances of such cases are almost or quite identical with some of the varieties enumerated above, the differences being dependent on their causation and clinical history. *See* DYSENTERY.

It frequently happens that the inflammation is limited to the lymphoid follicles, solitary and agminated, or at least primarily affects them. There is a great tendency for this condition to proceed to ulceration, which rarely extends beyond the mucosa, and never perforates. The ulcers coalesce, forming extensive areas of destruction, with undermining of the remaining mucous membrane. The ileum is seldom thus affected alone, oftener the ileum and colon, and most commonly only the colon.

In fatal cases of diphtheria in children the agminated, and to a less extent the solitary glands throughout the small intestine have been found much swollen and hyperæmic, though not ulcerated, and without diphtheritic membrane, although there was considerable round-celled infiltration of the mucosa and submucosa.

Various micro-organisms have been found in the tissues of the intestine in the different kinds of inflammation, both simple and specific.

SYMPTOMS.—That a considerable variation is met with in the kind and severity of the symptoms presented in cases of enteritis, is only to be expected when the great difference in degree and extent of morbid change that is met with is remembered; and in a very large number of cases the symptoms are quite out of proportion to the appearances found *post mortem.* Whilst the pathological changes that take place in a limited part of the canal are identical with those that may be found in another, to a very large extent the symptoms that arise in the two cases may be widely different. For whereas one patient may suffer from an attack of intestinal catarrh, with but a trifling array of symptoms, another may succumb within a few days. There is no one symptom or even group of symptoms that is absolutely characteristic of the disease; even the general condition of the patient is not constant. In the milder forms of intestinal catarrh there may be slight pyrexia, with thirst and quickened pulse, but these symptoms may be scarcely noticeable, and the actual existence of the condition is often assumed, without anything like proof; while, on the other hand, in the severe phlegmonous enteritis they are extreme, and the patient is in a state of considerable prostration.

The following symptoms, more or less marked, occur in different cases.

Stools.—Diarrhœa is in some respects the most constant symptom, though, when the affection is limited to the higher part of the canal, and space is given for the re-absorption of the excessive exudation, it may not only be wanting, but there may be actual constipation. The lower down the bowel is inflamed, the greater the liability to diarrhœa, which hence becomes a marked character of colitis and proctitis. In the severe forms of the affection complete constipation may be due to the paralysis of the inflamed bowel, arresting the peristalsis, and allowing of the accumulation of the intestinal contents above the lesion; this is obviously more complete when the enteritis is associated with any state producing mechanical obstruction, such as intussusception or ileus.

The character of the evacuations is very variable. As a rule they are semi-fluid when diarrhœa exists; or they may consist chiefly of an almost clear liquid with a few fæculent flakes; but, when time has permitted a partial re-absorption of the fluid portion, the stools become more consistent, and in cases of enteritis which are chiefly due to fæcal accumulation, solid, hard masses are passed.

Mucus, in greater or less quantity, is constantly present—being especially abundant in affections of the large intestine and rectum, when it is often discharged as complete tubular casts of the bowel. In catarrhal affections of the small intestine, the mucus may only occur in microscopic particles, and when considerable in amount and intimately mixed with the fæces, generally comes from the first part of the colon, as motions consisting of almost pure mucus come from below the splenic flexure.

Blood is not usual except in proctitis, or unless there be ulceration or hæmorrhoids; and pus is seldom noticed unless the rectum be inflamed. Quantities of intestinal epithelium and micro-organisms may be detected by the microscope.

Owing to the imperfect performance of digestion or absorption, the motions are liable to contain many abnormal constituents—as fat, when the duodenum and upper part of the jejunum are involved, or even masses of food scarcely changed; and the altered characters of the intestinal contents, with the products of decomposition, are in themselves most effective in maintaining a diarrhœa. As a rule, the discharges are paler than normal, or may be even colourless; the greenish tint so often seen in the enteritis of children is due either to a pigment formed by a bacillus, or to biliverdin, and is then considered as indicating some abnormal alkaline change in the intestine, whereby the biliverdin has become altered, though the stool itself as passed is acid in reaction. Unaltered bile pigment in the fæces is abnormal, and its presence indicates catarrh high up in the small intestine, and is always associated with fluid evacuations from increased peristalsis of the ileum and colon. The odour is usually extremely offensive or even putrid, especially the white or greyish putty-like masses passed by children; though sometimes, when the evacuations are very liquid and colourless, smell may be altogether absent. *See* Stools.

Owing to a large production of gases, discharges of flatus are of very frequent occurrence, but unless there be actual obstruction, tympanitic distension of the abdomen is not usual.

Vomiting, except in the severe forms, is not a common symptom of enteritis, unless the stomach be involved. In phlegmonous enteritis, however, vomiting may be persistent, and even stercoraceous; and it is relatively more frequent in children than in adults. Short of actual vomiting, nausea is frequently complained of.

Pain and tenderness.—Pain in itself is a most uncertain symptom, perhaps being scarcely noticeable in the milder forms of catarrh; whilst in colitis, the colicky, griping pains, which may or may not be relieved by pressure, are characteristic. Still more is this the case when the rectum is affected, when the straining and tenesmus constitute one of the most distressing symptoms of the malady. When the peritoneum is involved, the pain and tenderness are marked and characteristic. Both may be generally diffused over the abdomen, or may be local in character, as over the cæcum; in a large number of cases the pain is referred to the umbilical region.

General symptoms.—Among the more general symptoms, or those associated with inflammation of special regions, are the phenomena of the febrile state. The temperature may reach 104° F., or even higher; or in some cases it may be scarcely elevated. The appetite may be unaffected, especially if the upper part of the tract be free from the disease; whilst there may be complete anorexia when the reverse is the case. Thirst is of usual occurrence, and it becomes very marked when the evacuations are abundant and fluid. The tongue indicates rather the general state of the patient, and is a less reliable index of the actual state of the intestinal mucous membrane even than in corresponding affections of the stomach. It may be dry, red, irritable, and glazed; or coated with a thick fur, with the edges and papillæ bright and prominent; in milder cases it is often unaffected. The urine may contain a large amount of indican, indicative of albuminous putrefaction in the intestines. The character of the pulse varies with the general state. Provided that the pyrexia be extreme, there is the usual dry skin and concentrated urine, with a tendency towards the production of the typhoid state, which usually is reached in fatal cases. In many cases the prostration is excessive, though the mind is usually unaffected to the end, and very often there is a marked irritability of temper. Notwithstanding the intimate sympathy between the alimentary tract and the brain, headache is of rare occurrence in enteritis. A persistent hiccough is met with sometimes. In children the disease rapidly leads to a condition of collapse. The child lies in a languid, almost torpid, state; with the skin of the abdomen intensely hot and dry; whilst the extremities are cold and blue, the face is pinched, and the body generally appears shrunken. Frequently this state is interrupted by attacks of convulsions, especially if dentition be in progress. Or the child is extremely fretful, and maintains an almost constant, short, feeble cry, evidently accompanied with pain.

When the disease affects the duodenum, jaundice, due to closure of the bile-duct, very often occurs. The intimate nervous relation between the rectum and base of the bladder explains the frequency of micturition so commonly associated with proctitis.

Diagnosis.—The variability and oftentimes vagueness of the symptoms frequently admit of a diagnosis of enteritis being made only by a process of exclusion. The history of improper feeding, whether temporary or prolonged, often indicates the nature of the disease; though it cannot be denied that all rules of a rational dietary are frequently violated with apparent impunity both by children and adults.

Diarrhœa alone can by no means be taken necessarily to indicate the existence of intestinal inflammation, and the same may be said of constipation, pain, vomiting, and other single symptoms. It is rather to a group of symptoms, with the previous history, that the observer must look. The character of the stools, as already described, often indicates the region of gut affected; and the existence of extreme tenderness and pain, with a hard, quick pulse, and the abdominal decubitus, point to the involvement of the peritoneum, which an exacerbation of temperature tends to confirm. The distinctive features of typhlitis, colitis, and proctitis are elsewhere described sufficiently to form material for diagnosis in most cases. To distinguish between inflammation of the jejunum and ileum is usually impossible, nor, practically, is it a matter of importance. The history of the case, the course of the temperature, and the characteristic rash and headache, should serve to separate typhoid fever from acute enteritis, which is sometimes mistaken for it.

Prognosis.—This will clearly depend on the degree of severity of the affection, no less than on its seat and extent. Rest, which is of prime necessity to an inflamed organ, is almost incompatible with maintaining the due nutrition of the patient, and this fact renders the prognosis very uncertain.

A simple intestinal catarrh occurring in a healthy subject certainly tends, after a few days, to complete recovery; but occurring, as it frequently does, in persons in ill-health, it is far more liable to pass into an obstinate chronic condition. In children, the opinion should be very guarded; for whilst in a large number of cases perfect recovery follows removal of cause and suitable treatment, others, for no very apparent reason, will, in spite of everything, progress to a fatal termination; and this is, of course, more likely to be the result where a strumous or tubercular diathesis exists. The mildest diarrhœa in children suffering from athrepsia quickly becomes serious, killing as it were from rapidly supervening shock; the onset of so-called summer diarrhœa during convalescence from such diseases as whooping-cough or pneumonia is also of grave import; and in true cholera infantum, hyperpyrexia, great prostration, and especially uncontrollable vomiting, are almost surely fatal indications. Enteritis in different degrees of severity constitutes one of the most important causes, if not the most important cause, of infantile mortality.

In the severer forms of enteritis, as they affect adults, opinion must be guided by the nature of the cause, and the general state of the patient. Recognising that the unfavourable tendencies of the disease are towards extreme prostration, to perforation with fatal collapse, or to chronic ulceration—according as these conditions are threatened, so may the prognosis be fairly made. The duration of extreme cases rarely extends beyond a few days, when, if death do not occur, the symptoms abate, and recovery, with oftentimes a tedious convalescence, follows, or a chronic condition of disease is established. A very insidious form of enteritis, with rapidly fatal termination from ulceration and perforation, has been noticed in young girls, the symptoms only lasting about twenty-four hours.

Treatment.—Although great variety exists in the degree of severity of the symptoms of acute enteritis, and a corresponding difference obtains in the treatment to be pursued, yet certain general principles may be first laid down, and the more special details adapted to certain conditions afterwards indicated. Inasmuch as the disease is one of a febrile nature, where, among other things, the tissue-waste is out of proportion to the repair, and at the same time the organs concerned with the preparation of the food are those mainly at fault, every effort should be made to minimise the bodily waste. This is best attained by keeping the patient in bed, which also offers the additional advantage of providing a uniform warmth.

As regards diet, in the greater number of cases of acute intestinal inflammation the appetite is much impaired, even to complete anorexia. Providing the person attacked have been previously in good health, no harm is done by complete abstinence from food for twenty-four or even forty-eight hours. This gives a much better chance of rest to the intestine, and a better opportunity for the removal of any irritant ingesta which may have been the cause of the inflammation. The thirst during this period may be relieved by ice-cold water, with or without a little lemon-juice. It must not be forgotten that, with the mucous membrane and its glands inflamed, the conditions of normal digestion and absorption are materially interfered with, and articles of diet that ordinarily are most nutritious and easily digested, may and do become, under these altered circumstances, positively harmful. The aim in feeding the patient should be to give those materials which require the least digestion, and, being most quickly absorbed, leave the smallest amount of indigestible residue. Provided that the stomach be implicated—and it is rare that it is not so—meat foods are badly borne. Instead of the proteid constituents being digested, they undergo putrefactive decomposition, and thus add fresh irritants to the canal lower down. If, however, the stomach be tolerably free, then meat essences, made thin and allowed to stand till cold, may be given. The nausea or vomiting which is usually present is more easily overcome by giving the nourishment cold; and a few drops of lemon-juice are of great service if added to the beef-tea. Milk is very uncertain in the way it is tolerated by such patients. Occasionally it is impossible to give it, the vomiting or diarrhœa being increased by it; but equal parts of milk and soda-water may constitute sufficient nourishment to last for several days in extreme cases, and may be well borne. Lime-water may be substituted for the soda-water, but, as a rule, effervescing fluids are more grateful, koumiss being often of great service. The milk should be sterilised and as free as possible from cream, for fats in all forms are to be avoided, since the products of their decomposition are extremely irritating. Beef-tea or chicken-broth, made with milk in place of water, may be tried with advantage. Farinaceous substances, if given at all, should be only in small quantities at a time; a remark which equally applies to all other food. Nutrient enemata are of much use in some cases.

A very great deal may be done for the patient with drugs, both in the relief of symptoms and in aiding the cure.

It is seldom advisable to check the diarrhœa in acute enteritis; and an aperient to begin with, except evidence exist of there being any peritonitis, is a rational treatment. Thereby the irritant, whatever it may be, is removed, and a better chance for recovery is given; improper food is so commonly the cause, that the majority of cases are benefited by a preliminary purgation. Probably the best aperients in this case are castor oil, and calomel in doses of one to four grains according to age, but it may be necessary to follow up the latter after a few hours with a quickly acting saline aperient. If the inflammation be confined to the colon, where, as already said, accumulations of fæces are the common cause, copious simple enemata, repeated every six or eight hours, are of great advantage; and this plan may be pursued in conjunction with the aperient given by the mouth. The object is to clear out the alimentary canal; and provided that this has been done, abstinence from food for twelve hours, and some bismuth in an effervescing form, are frequently sufficient in milder cases to put the attack on the road to cure. The writer places great reliance on bismuth, either in the form of solution with an effervescing citrate of potassium, and three or four minims of diluted hydrocyanic acid; or granular effervescing lime-juice and bismuth. The nausea and vomiting are best relieved by this treatment. For the pain, poultices or poppy-head fomentations, or the internal administration of opium, may be very effective. Should there be peritonitis, the opium must be increased in amount, to the end of giving complete rest to the bowel. Several leeches applied to the anus, with the view of relieving the hyperæmia of the intestinal tract, are occasionally necessary in extreme cases. When the attack is distinctly attributable to cold, a profuse sweating induced by hot baths, and ten grains of Dover's powder, is often of great benefit. In those cases where, from the duration, character of stools, and previous treatment, there is reason to believe that the irritating causes are got rid of, the diarrhœa may then require special treatment, especially when the patient has been in ill-health, or is constitutionally debilitated. A powder, consisting of Dover's powder 5 grains, and carbonate of bismuth 10 grains, given every six hours, is very efficacious. Sulphate of copper, nitrate of silver, and vegetable astringents are frequently used for the same purpose.

So soon as the more acute symptoms have subsided, the bismuth may be still continued, and presently given with a vegetable bitter, such as calumba. But ten to fifteen minims of the diluted hydrochloric acid in an ounce of water much assist the recovery of the digestive power of the stomach, for which purpose also pepsin is valuable.

In consequence of the great liability to a second attack which this disease engenders, avoidance of well-known harmful articles of diet, and the use of warm clothing or flannel belts, are demanded as a prophylaxis.

In infants and young children the great liability to collapse, often rapidly fatal, must be borne in mind. Stimulants in some form are almost a necessity. The following prescription may be employed: Liquoris Bismuthi et Ammonii Citratis ♏j–iij, Spiritus Ammoniæ Aromatici ♏ij–v, Tincturæ Cardamomi Compositæ ♏ij–v; Aquæ ʒj–ʒij—according to age. Brandy in small quantities is often the means of saving life in these cases. When the collapse is not threatening, two or three drops of the official solution of corrosive sublimate, with half a fluid-drachm of syrup, and a fluid-drachm and a half of water, every two or three hours, may be of great service. It is a more convenient mode of giving mercury than in the form of grey powder. But in one form or another the writer believes mercury to be of prime necessity. Corrections of diet on the lines indicated above are of course essential. Hot baths and other means to keep the child warm must be employed.

In the severer cases, which are lapsing into the typhoid state, the general principles for that condition must be followed; but, except in such a state, alcoholic stimulants are rarely called for.

Inasmuch as there is good reason to believe that many cases of intestinal inflammation, especially those of an epidemic character, are due to the activity of micro-organisms, the treatment of the disease on antiseptic principles has naturally been suggested. The problem has been to find a germicide which should pass to the ileum and colon without itself undergoing decomposition in the mouth, stomach, or upper part of the intestine, and should at the same time be harmless to the patient. Many are the agents which have been proposed, and with varying success. Few, if any, are superior to calomel or corrosive sublimate, or the solid preparations of bismuth. Thymol and salol are occasionally useful, but these latter, like resorcin, salicylic acid, salicylate and benzoate of sodium, salicylate of bismuth and cerium, the sulphocarbolates of sodium or zinc, creasote, naphthalin, iodoform, and peppermint, are far more efficacious in checking fermentation in the stomach and upper bowel. Whichever remedy be employed, it should be given in frequently repeated doses according to age. Irrigation of the colon by copious enemata of water, containing small proportions of one or other of the above-mentioned substances, is an effective method of intestinal antisepsis.

(*B*) Chronic Enteritis.

Ætiology.—1. A certain proportion of the acute cases become chronic, the original cause persisting.

2. Those conditions which lead to a chronic state of congestion of the intestinal tract will thereby so affect the constitution of the tissues, with a consequent disturbance of function, as to constitute a chronic inflammation. The most important of these conditions is obstruction, either at the right side of the heart, or affecting the portal circulation in the liver.

3. Chronic enteritis is the occasional accompaniment of some general chronic disease, such as Bright's disease, when deteriorated blood may be regarded as leading to a chronic inflammation.

4. Residence in tropical climates is a not infrequent cause of lasting inflammatory disease of the bowels.

Anatomical Characters.—The intestinal mucous membrane, when it has been the seat of chronic inflammation, is generally thickened, tough, and of a grey colour, from a deposition of pigment, due to the chronic congestion. The epithelial cells are cloudy and ill-defined, and there is a round-celled infiltration of the mucous and submucous layers passing into the stage of connective tissue; hence the thickness and toughness. This fibrous hyperplasia is often localised as polypoid elevations with intervening areas of atrophic mucous membrane. The lymphoid follicles are prominent and hard; the intestinal glands are frequently blocked with cells and secretion, and form minute solid, though perceptible masses, or are atrophied or even cystic; and the villi of the small intestine are shrunken and stunted. The surface of the membrane is more or less covered with a viscid glairy mucus, containing pus and imperfectly formed epithelial cells; not infrequently such mucus may be voided in the form of membranous-looking shreds or even complete casts of the tube, and this is particularly the case in the pellicular form of colitis (*see* Casts). Sometimes the muscular coat is thickened from connective-tissue formation. As a rule, therefore, the bowel is increased in thickness; but in children it not infrequently happens that a chronic enteritis is associated with an atrophy of all the coats and the contained glands, the tube being much thinned and parchment-like, and of a slaty tint. It is unusual for a chronic inflammation of the intestine to exist in adults without coincident ulceration, which is often most extensive; but in children the disease may proceed to a fatal termination, and show no such condition after death.

Symptoms.—It is not always easy to say exactly when an acute case has lapsed into a chronic state, very much the same symptoms being continued. In such affections of the small intestine, the diarrhœa may be wholly wanting, and the bowels may be very confined. This is due to the diminished peristalsis, from œdema of the muscular coat and impaired irritability. When, however, ulceration is extreme, and especially if it be the colon or rectum that is mainly affected, chronic diarrhœa is an invariable symptom. The remarks made on the character of the stools in acute enteritis are equally applicable to the chronic state, with the addition, that solid and liquid evacuations frequently alternate. Lasting as the disease often does for many months or even years, a general impairment of nutrition results. The function concerned in the elaboration of the food, as well as that by which the digested products are absorbed, are necessarily perverted. The marasmus is speedily noticed in infants and children, whose growing tissues the less readily withstand malnutrition. Apart from the general ill-health produced, the mental qualities become affected, so that the intellect may become dulled and sluggish, the temper irritable, and the patient may fall into a condition of marked hypochondriasis; this is particularly liable to be the case when the colon is the seat of the disease. The emaciated appearance; the dirty, muddy complexion; complicated often with a short, dry cough, dependent on reflex causes from the stomach, frequently lead a superficial observer to suspect the existence of phthisis.

That form of enteritis which chiefly occurs in the colon, and is characterised by the passage of mucoid shreds and 'casts'—the 'membranous enteritis,' 'mucous colic,' or pellicular colitis of writers, is accompanied by a fairly definite group of symptoms, and is, the writer believes, of far more common occurrence than is generally supposed. The patients are most frequently women, especially those of a nervous temperament, both single and married. The malady is very persistent, but is particularly characterised by manifesting itself in periodical attacks, with intervals of moderately good health. The attacks, lasting a few days to a few months, may follow an indiscretion in diet, exposure, or mental disturbance, but not unusually occurs without any obvious cause. The symptoms are abdominal pain and tenderness along the course of the colon, vomiting, which is often considerable, and a sense of severe illness, together with great irregularity of bowels, the motions containing much mucus and shreds of various size, with very often some blood.

Diagnosis.—The grounds on which a diagnosis can be made are sufficiently obvious from a consideration of the foregoing remarks.

Prognosis.—Chronic enteritis almost invariably tends towards a fatal termination, though this may be long delayed. As already said, it is, at least in adults, the colon that is chiefly the seat of this malady, where it is very often associated with ulceration, obstinately resisting all treatment, which at best can only be palliative; the general nutrition becomes more and more deranged; and death from inanition finally terminates an existence of prolonged suffering and discomfort.

Treatment.—Owing to the unfavourable tendency of this disease, the treatment can be rarely more than palliative. The debilitating and wearying character of the malady emphatically calls for good feeding. The diet should be abundant, no less than nutritious. During the exacerbations of membranous enteritis above described, the giving of food is often difficult owing to the vomiting and pain produced; in such cases koumiss is of great value. When the disease affects the large intestine, the ordinary digestive changes in the food have taken place, and the contents of the canal reach the colon in the normal semi-fluid condition; in this state they may be passed; but owing to the impaired movements of the affected bowel the fæces are apt to accumulate, and constipation results. This should be guarded against by simple enemata, and the soothing effect of injections of warm water only is often very marked. Distinct benefit has been known to follow hydrotherapeutic treatment, especially if accompanied by free rectal injection. In those cases where the enteritis is a sequence of a congestion of the intestine, the treatment must be directed to relieve if possible the cause of that congestion. Since this is usually some such intractable condition as Bright's disease, cardiac dilatation, or cirrhosis of the liver, attention should be directed to the relief of these affections.

Tonics—such as quinine, iron, bark, with sea air—are of undoubted benefit; and, so far as possible, causes of mental worry should be removed. Massage of the abdomen and gentle movements specially directed to the exercise of the abdominal muscles are most beneficial.

14. Intestines, Malformations of.—These may be (*a*) *congenital*; or (*b*) *acquired.*

(*a*) *Congenital.*—Though seldom of much clinical importance, congenital malformations of the intestines are often of great interest from a developmental point of view. The malformation may be of the nature of an *excess.* Thus certain parts of the canal—duodenum, colon, and appendix vermiformis—have very rarely been found double. The commonest of all these malformations is a diverticulum of the ileum, which may arise from the free margin of the ileum from one to three feet above the ileo-cæcal valve. The cæcal extremity of the process (which is occasionally hammer-shaped) may be connected with the umbilicus by a thin fibrous cord, showing it to be an unobliterated portion of the vitelline duct, and is commonly known as Meckel's diverticulum. It varies in length from half an inch to six inches, or even more; in structure it is exactly that of the ileum; and it has been found the seat of typhoid ulceration, or of perforation from the irritation of foreign bodies that have become lodged therein. In very exceptional cases diverticula of similar structure have been found protruding from the jejunum, and even multiple, but they are not connected with the umbilicus. The vermiform appendix may vary from half to twice the natural size.

Deficiencies of development may affect the whole alimentary canal, or only certain parts. Andral records a case where only a straight tube joined the rectum and œsophagus. The ileum may open upon an ectopic bladder. The rectum may end in a cloaca common to the urino-genital organs, or in either the bladder, urethra, or vagina. The bowel may terminate in a closed extremity anywhere between the brim of the pelvis (the rectum being generally represented by a fibrous cord, though even this may be wanting), and immediately beneath the skin; the anal pouch, which develops from without inwards, is in the latter case absolutely wanting; and all degrees between this and a pouch that has just failed to establish a junction with the rectum may be met with, producing the lesion known as *imperforate anus.* The valvulæ conniventes are sometimes wanting, or very imperfect, over varying areas of the small intestines. Congenital constrictions of different parts of the canal are occasionally met with—in the duodenum, either close to the opening of the common bile-duct or at the junction with the jejunum; in the lower end of the ileum, where some abnormality in the closure of the vitelline duct appears to be the cause; or in the sigmoid flexure. Such constrictions may be multiple and of very short extent, the canal being much dilated above, and extremely narrowed and shrunken below. The ileocæcal orifice has been seen contracted to the diameter of a small cedar-pencil. The cause of these lesions is very obscure, though they may be occasionally accounted for by the existence of prominent valve-like folds of the mucous membrane.

Hernial protrusions of the mucous membrane through the other coats, often very numerous, and varying in size from a pin to a walnut, have been seen in the colon, and less often in the small intestine, sometimes extending into the appendices epiploicæ. They are liable to become developed in cases of long-standing constipation.

(*b*) *Acquired.*—The acquired malformations include the dilatations and contractions that are associated with stenosis; and the adhesions and abnormal communications established by ulceration and peritonitis, elsewhere referred to.

When any symptoms are produced by malformation of the intestines they are usually those of obstruction; and the only condition that may be amenable to treatment is imperforate anus. *See* INTESTINAL OBSTRUCTION; and ANUS, Diseases of.

15. Intestines, Malignant Disease of.—The new-growths which are met with in connexion with the intestine may, for the present purpose, most conveniently be divided into *malignant* and *non-malignant* —a clinical distinction irrespective of their minute structure.

ÆTIOLOGY.—Malignant growths of the intestine, as in other situations, whilst not wholly unknown in the earlier periods of life, are rarely met with before the age of forty and oftener after fifty. Statistics show a slight preponderance of occurrence in males. From an examination of 9,000 fatal cases of cancer, the relative frequency of intestinal cancer to that of all other organs was found to be as 1 to 25 (Tanchou).

Cancer of the intestine is nearly always primary, and very frequently runs its course without any secondary formations elsewhere. Occasionally the bowels are affected by extension from neighbouring parts, and this is especially liable to be the case in the rectum, when the uterus or vagina is the seat of the disease, and in the duodenum, which may become involved in an extension from the pancreas, liver, gall-bladder, or stomach. Very rarely small nodules are found in the solitary and agminated glands secondary to carcinoma existing elsewhere.

ANATOMICAL CHARACTERS.—Malignant disease may occur at any spot throughout the entire length of both small and large intestine, but is infinitely more often to be met with at certain special parts, notably the rectum, sigmoid flexure, cæcum, colon generally, and duodenum near the opening of the bile-duct; the jejunum and ileum being rarely affected. It has been estimated that in 80 per cent. of the cases of intestinal cancer the rectum is affected; in 11·5 the colon; in 4·2 the cæcum, appendix, and ileo-cæcal valve; and in 4·3 the small intestine. There is undoubtedly a predilection for those spots where any delay may occur in the passage of the intestinal contents, such as the flexures of the large intestine, especially the sigmoid.

The greater number of intestinal growths included in the category of malignant are of the epitheliomatous type, especially the cylindrical and glandular varieties; somewhat less frequent is the colloid form; whilst the scirrhous and encephaloid are much rarer. As a rule, malignant growths commence in the mucosa and submucosa, and then gradually involve the other tissues. The microscopic characters of these new-growths present no special features. *See* CANCER.

The mesenteric glands are generally affected, though often but slightly. Secondary infection is much less common than in cancer of other organs; when present, the liver and peritoneum are the usual seats.

Following the general course of these neoplasms when found elsewhere, they may undergo degeneration and ulceration, thus suffering a diminution in bulk at one spot whilst they extend in other directions. In the course of their development they may set up adhesions between the bowel and other parts; and two or more coils of intestine may be thus involved, and fistulous communications established between them. The colloid form is the more liable to invade the peritoneum, where large gelatinous masses may be developed.

The new-formed tissue may constitute an irregular mass of very variable size and extent, of a nodulated or of a villous appearance, perhaps partially ulcerated, and extending into the passage of the canal, producing an obstruction. Or the new-growth may develop in an annular manner, involving the whole circumference of the bowel; the obstruction produced in such circumstances may be extreme, even to narrowing the lumen of the tube to barely the size of a probe. The extent of obstruction may be altered by partial destruction of the new-growth by sloughing, though the subsequent cicatrices that may result will again constrict the gut.

SYMPTOMS.—For a varying time before this disease definitely asserts itself, the patient may complain of vague dyspeptic symptoms; a sense of uneasiness in the abdomen, not amounting to pain, and usually increased after meals; and marked irregularity in the action of the bowels, with or without flatulent distension, and an increasing tendency to constipation, for which the patient has often taken enormous quantities of aperients of a drastic and cathartic character, which one by one lose their effect. The persistence and gradual increase of these symptoms, especially if there be any loss of flesh, is very significant, and should excite suspicion. Sooner or later, according to the duration of the case, the usual cachexia is established; and in the greater number of cases the patient rapidly emaciates, especially towards the end, though in cases of very short duration the wasting may not be so excessive. The emaciation depends not only on the general perversion of nutrition caused by the development of the cancer, but also on the direct influence it exerts on organs concerned in the digestion and absorption of nutriment; hence the higher up in the bowel the growth is situated the sooner is the loss of flesh determined.

The local signs and symptoms referable to the new-growth itself are very variable in their occurrence, and often are singularly slight in comparison with the gravity of the cause. Thus pain may be completely wanting, and perhaps there is but little tenderness on pressure; when present the pain is usually of a dull character, and quite localised.

The indications of the tumour produced by the new-growth are very uncertain, being often little more than an ill-defined fulness in one region, scarcely even amounting to that in the annular form of cancerous stricture; at other times presenting a distinct hard irregular mass of variable size. This last quality, being partly dependent on fæces, is very characteristic. Should the growth happen to be situated over the aorta or iliac arteries, an indistinct pulsation may be communicated to it. The percussion-note over the tumour is usually imperfectly tympanitic, from the existence of coils of intestines between it and the abdominal wall, the thickness of which will of necessity considerably modify the signs of the existence of the growth. The mass may present all degrees from free mobility to complete fixity, dependent on the nature of its seat, and also on the existence of adhesions to neighbouring parts.

Symptoms of intestinal obstruction are rarely wanting, and may be the first for which the patient seeks relief. Vomiting, constipation of increasing severity, with signs of intestinal distension above the lesion, are among the most constant. The character of the vomit will largely depend on the duration and situation of the lesion, and the actual degree of obstruction. When the jejunum or lower part of the duodenum is the seat of the growth, the vomiting is more copious and constantly bile-stained, the bowel and stomach above the stricture sharing in the distension. When the obstruction is lower down, in the large intestine, the vomiting may be slight, and consist of little more than the gastric secretions, with such food as is taken, only becoming stercoraceous when the obstruction becomes complete. Occasional diarrhœa, determined by the chronic enteritis which exists, may alternate with the constipation; and rupture of the intestines, especially the cæcum, has been met with as a result of the atrophy and ulceration of the over-distended, chronically inflamed bowel. As in other forms of intestinal obstruction, the amount of urine voided is likely to be very much diminished when the stricture is high up, and the vomiting is excessive. *See* INTESTINAL OBSTRUCTION.

The stools are usually characteristic of the obstruction, consisting of small separate masses, frequently hard and round, or flattened or 'pipe-stem' like, and often mixed with sloughed-off portions of the new-growth, or with blood that has escaped from the ulcerated surface. The nearer to the anus the growth is situated, the less change will there be in the blood, which sometimes may be considerable in amount.

If the peritoneum be involved, peritonitis may arise; and ascites, often considerable, is usually developed with colloid cancer. Superadded to these symptoms will be those caused by the morbid condition of any other organ that may be affected, such as the liver, bladder, or uterus.

COURSE AND TERMINATIONS.—Malignant disease of the intestines in the majority of cases progresses continuously. It is difficult to state even an average duration, owing to the insidious onset and vagueness of the first symptoms; but the greater number of cases rarely go beyond twelve to eighteen months from the time when the disease is clearly established, whilst some may be fatal in a few weeks, and a few may last for years.

Death may result as the direct consequence of the cachexia; or from hæmorrhage, peritonitis, or other effects of the growth.

DIAGNOSIS.—An exact diagnosis is often not to be made, and the nature of the case remains throughout uncertain, if not actually as to the existence of a malignant growth, at least as to the seat of it. The insidious and ill-defined character of the earliest symptoms presents nothing diagnostic, though their progressive character and resistance to treatment would cause a suspicion, especially in a person over middle age, and in whom a gradual even though slight loss of weight is noticed. Even in the later stages, the symptoms are almost identical with those of chronic enteritis, which really co-exists with the new-growth to a greater or less extent; and in the not infrequent cases in which a tumour is not to be felt, or is uncertain in its indications, the diagnosis becomes extremely difficult. Some cases also in which the new-growth is unrecognisable to palpation, and at the same time causes little or no obstruction, closely simulate in their course diseases of the suprarenal capsule; for the latter are not invariably accompanied by cutaneous pigmentation, and the rapid and progressive emaciation, with more or less persistent vomiting, may be common to both. It is true that the malignant cachexia is frequently productive of a characteristic *facies*, but this would equally occur in cancer of the capsules.

Supposing that the existence of an abdominal tumour be clearly ascertained, it is not always easy to determine its connexion with the intestine, since the variability in position, in mobility, and in size (due to the accumulation, or the reverse, of fæces), precludes any diagnostic sign, although this very variability is regarded by some as almost indicative of intestinal cancer. In distinguishing between an intestinal tumour and one connected with the liver, pancreas, kidney, mesenteric glands, uterus, abdominal wall, or the inflammatory new-growth following a perityphlitis, an aneurysm, or a simple fæcal accumulation, the history of the case, age, progressive nature of the condition, existence of tumour, signs of obstruction, and character of the stools, are the points to be considered in forming a diagnosis. Any one or even two of these points might equally indicate other lesions, but, taken collectively, they will usually justify the formation of an opinion. A rectal cancer, which is accessible to the touch or even to inspection, need offer no difficulty, but it is otherwise where it comes to distinguishing a duodenal growth from one strictly limited to the pylorus. The vomiting in the latter case is more persistent than in the former, and there is a greater liability to hæmatemesis; but these are most uncertain signs, as also is the existence of jaundice, which oftener complicates the duodenal affection, from the greater chance of involving or pressing on the bile-duct; but jaundice is not a necessary accompaniment. A firm epigastric tumour, felt close to the margin of the thorax, and associated with distinct dyspeptic symptoms, may also be due to primary cancer of the head of the pancreas; in such case the symptoms of obstruction are less marked at first, but the growth will probably involve the bowel in its progress, and cause stenosis; owing to the destruction of the gland-tissue, the pancreatic juice is not secreted, and undigested fat may be found in the stools.

Similar difficulties may surround the investigation of a tumour situated in the right iliac fossa. Emaciation, constipation, and melæna might equally indicate a malignant tumour of the cæcum, or the remains of a chronic perityphlitis.

Treatment.—The extremely rare cases of reputed natural cure of malignant disease of the intestines, brought about by sloughing of the growth and subsequent cicatrisation of its site, afford no hope of our being able to artificially imitate the process, and the treatment remains at the best symptomatic and palliative.

The diet should be so arranged as to contain the minimum of indigestible residue, and permit the chief digestion and absorption in the stomach, if it be the upper part of the tube that is affected. But in the majority of such cases the utmost disinclination from food exists, even apart from any vomiting or pain its ingestion may produce, and hence, whatever the directions, the patient in the later stages practically takes nothing. The anorexia is frequently as marked even when the mischief is seated in the colon, and the area for digestion and absorption is uninterfered with.

In the earlier stages it may be advisable to insist upon as much nutritious food as possible being taken, either by the mouth or in the form of enema or suppository, so as to offer the most prolonged resistance to the inevitable end; but at the same time there is no slight reason for thinking that the same course favours the speedier development of the new-growth. Preparations of iron may be given with the same view.

The symptoms dependent upon the obstruction we can do very little to relieve short of operation. Only the mildest aperients are permissible, to combat the constipation, and these should be salines with the object of rendering the fæces as fluid as possible; while the vomiting is as a rule uncontrollable, and, indeed, is often a relief.

Hæmorrhage may require special attention, the tincture of hamamelis being among the most effective styptics; and the pain may be so severe as to necessitate free administration of morphine subcutaneously; in other cases belladonna is of value in alleviating the local discomfort, and acts favourably by allaying any spasm.

The operative treatment of malignant disease of the intestine is described in the article Intestinal Obstruction.

16. Intestines, Malpositions of.—Displacements of the intestines, like malformations, are both *congenital* and *acquired.*

Among the former may be mentioned complete transposition of the viscera, the cæcum and ascending colon being on the left side, and the sigmoid flexure and descending colon on the right, the liver, spleen, stomach, &c., sharing in the change. Certain parts only of the intestinal canal may occupy an abnormal situation, as seen in the various congenital herniæ; or the displacement may be due to unusual length of the mesenteries, the cæcum and sigmoid flexure being the parts that present the most usual alteration from this cause. Thus the cæcum may occupy the left hypochondrium or left iliac fossa, or be found in the pelvic cavity, and, of course, other parts of the canal must correspond to these malpositions. The sigmoid flexure has been seen lying to the right side of the left kidney, which was situated immediately below the bifurcation of the aorta. Similar displacements are referable to adhesions, determined by intra-uterine peritonitis, which is frequently associated with syphilis.

The malpositions which the intestines may come to present from changes set up after birth are so variable as scarcely to admit of classification. Hernia, both external and internal, volvulus, and intussusception are among the well-recognised displacements; but there is scarcely any limit to the changes in position which the traction and pressure of tumours and the effects of peritonitis may produce. *See* INTESTINAL OBSTRUCTION; and HERNIA.

17. **Intestines, Micro-organisms of.** The intestinal canal from within a very few hours after birth, to judge from the fæces, swarms with numerous forms of microbes, which, having gained entrance with the food and air, find in the canal suitable conditions for their development. Our present knowledge would lead to the belief that many of the species have no effect upon the human body, whilst others take an active share in intestinal digestion, as effective though wholly superfluous aids to the pancreatic secretion. How far any of these, which may be regarded as normal inhabitants of the canal, may under certain conditions of the contents or excessive development, &c., become responsible for symptoms of disease, is not known with certainty, though it appears probable such may be the case. But it is now well recognised that certain specific diseases, such as tuberculosis, cholera, and typhoid fever, are connected with specific organisms which, gaining admission with the ingesta to the alimentary canal, produce the characteristic symptoms of these several diseases.

Besides various micrococci, the most constant members of the schizomycetes found in the intestines are the bacillus lactis aërogenes, chiefly in the upper part of the canal, and the bacillus coli commune, most abundant in the colon. Certain other species, such as Brieger's bacillus or bacillus cavicida, Bienstock's putrefactive or 'drumstick' bacillus (?), a putrefying green fluorescing bacillus, and various spirilla, are met with in the evacuations of patients suffering from different forms of enteritis; and it is probable that the poisonous substances which these organisms form from the intestinal contents, especially the albuminous, take a large share in the causation of the disease, or at least that many of the symptoms are to be referred to the ptomaïnes which are absorbed. But our present knowledge does not enable us to associate with each of the multiform diarrhœal conditions which occur its own specific causal organism, as we can do in the case of cholera or typhoid fever.

Actinomycosis has been met with in the intestine, where it forms raised whitish patches, setting up inflammation, and proceeding to abscess, which may burst into the peritoneum or present at the integuments. As the disease spreads, some healing may take place. *See* ACTINOMYCOSIS; and MICRO-ORGANISMS.

The bacillus anthracis also occurs in the intestine, causing swollen œdematous patches of the mucous membrane, which are intensely congested and rapidly slough. The intestinal lesion may be primary, or it may be part of a general infection. *See* ANTHRAX.

A few species of the yeast fungi or saccharomycetes, such as torulæ, and of the hyphomycetes or moulds, such as the oidium albicans or 'thrush,' occasionally develop in the intestines.

18. **Intestines, Morbid Growths of.** Owing to the variety of tissues that enter into the formation of the intestine, no less than to the origin of these tissues from two of the three primary layers of the blastoderm, the new-growths that may develop in connexion with it are exceedingly numerous.

It will be convenient here to consider them from their clinical rather than from their genetic or histological point of view, and to divide them into *malignant* and *non-malignant* growths. The former have already been treated of, and the special neoplasms of tubercular and syphilitic origin are more conveniently referred to separately.

VARIETIES.—1. *Fibromata.*—These growths, which are developed from the connective tissue of the submucous coat, are usually of small size, frequently pedunculated, though sometimes appearing as sessile, flattened nodules, of half the size of a pea, projecting into the canal. The smaller ones may be scattered throughout the length of the bowel, whilst the larger ones (up to the size of a walnut) are fewer in number or single, and are usually found in the rectum. They present the ordinary microscopic characters of fibrous tissue.

2. *Lipomata.*—Pedunculated growths of adipose tissue, springing from the submucous coat, are not of uncommon occurrence in any part of the intestines.

3. *Myomata.*—Very rarely small growths are met with, chiefly composed of contractile fibre-cells, with a variable amount of connective tissue.

4. *Vascular tumours.*—*Angiomata.*—Besides hæmorrhoids, other vascular growths are sometimes found, of an erectile character, similar to nævi of the skin.

5. *Mucous growths.*—It is to these growths that the term 'polypi' is generally applied. They essentially consist of the tissues of the mucous membrane, though differing in their vascularity, and also in their glandular ele-

ments. When these latter are excessive in amount, they are liable to present characters which connect them with malignant forms of new-growth, especially if their surface assume a villous character. Polypi are not limited to any one part of the canal, though undoubtedly they are most common in the rectum, and are sometimes pigmented. They are occasionally multiple, 170 have been seen in the lower half of the colon in a single case; and have been met with at all ages.

6. *Lymphoid growths.—Lymphadenomata.*—Neoplasms whose structures correspond to that of the solitary or agminated glands, or of the lymphoid layer of the submucosa, are met with in association with these normal constituents of the intestinal wall, and quite independently of leucocythæmia. Nodular formations and diffuse infiltrations of similar structure have been met with throughout the stomach and intestines in Hodgkins' disease (lymphadenoma), but though giving rise to large masses, they produced no obstruction.

7. *Sarcomata.*—Small nodules of this type of neoplasm have been described as of very rare occurrence in the intestine.

8. *Cysts.*—These have been rarely met with, and the contrast to their comparative frequency in the uterine mucous membrane is remarkable. Several instances are on record of congenital dermoid cysts which have been found attached to the rectum or sigmoid flexure, and probably originating from the neurenteric canal.

Cystic enlargement of the vermiform appendix, or of diverticula of the intestine, may follow on closure of their communication with the lumen of the bowels, and accumulation of fluid in their interior—*enterocystomata.*

Effects and Symptoms.—As a rule, the growths mentioned above present very little interest, unless they be situated just within the rectum, and accessible to digital examination, for it is seldom that they are of sufficient size to form tumours which can be felt in the abdomen. They cannot be diagnosed, though they may give rise to certain symptoms, as, for instance, hæmorrhage from the vascular polypi and erectile tumours, or partial obstruction if they attain any size; but such symptoms are not diagnostic. One of their most striking effects appears to be the liability that the polypoid forms occurring in the small intestine have of inducing serious intussusception, from interfering with the due progress of peristalsis. Prolapse of the rectum is similarly found to be occasionally due to polypi.

Treatment.—No treatment can be attempted, beyond that of the symptoms which may arise; or the removal of growths within reach of the anus, or very exceptionally by laparotomy.

19. **Intestines, Paralysis of.**—The peristalsis of the intestinal tube is normally dependent on automatic nerve-impulses, originating in the intrinsic ganglia of the canal, controlled by both reflex and direct impressions from the cerebro-spinal and sympathetic systems, the former acting *viâ* the vagus in an accelerating manner, the latter *viâ* the splanchnics in an inhibitory direction. The integrity of the involuntary muscular fibre is assumed. The quantity and the quality of the blood in the vessels of the intestines also appear to modify peristalsis, since the movements are increased both when there is anæmia and hyperæmia of the canal, probably owing to the diminution of oxygen and excess of carbonic acid, which these conditions equally determine.

Ætiology and Pathology.—A paresis of the intestinal movements may be brought about by causes acting (1) through the *nervous system*; or (2) through imperfection of the *muscular tissue.*

(1) *Nervous.*—Cases are recorded in which the intrinsic ganglia and nerves of the intestinal muscular coat have been the seat of degeneration, but the symptoms dependent thereon are doubtful, beyond atrophy of the muscular coat. Certain lesions of the brain are accompanied by symptoms of intestinal paralysis, but with no hitherto recognised regularity, and it is assumed that such lesions act by interfering with the function of the vagi. It is doubtful how far disease of the spinal cord produces actual paralysis of the intestines, though constipation may result, a circumstance that may be explained by assuming an interference with the centre that controls defæcation. *See* Fæces, Retention of.

(2) *Muscular.*—The irritability of the muscular tissue may be much weakened by degeneration (cloudy, fatty, or lardaceous). Inflammation of the mucous or serous coat, especially the latter, is liable to determine granular change in the muscular fibres, which, aided by a coexistent œdema, largely impairs the contractile power of the tissue. Chronic congestion of the bowel leads to the same result. The irritability is also liable to suffer from the over-stimulation of too powerful and too frequent purgative medicines; and the muscular fibres of a much dilated portion of the bowel are apt to become paralysed from distension and stretching. The general want of tone that the muscular and nervous systems manifest subsequent to debilitating diseases, or from want of food, hysteria, and other conditions, also finds expression in the alimentary canal, in diminished peristaltic action.

Certain astringent drugs produce their effect possibly by diminishing the excitability of the nervous system, as appears to be the case with opium. Lead, which would seem to cause both paralysis and spasm of the muscular coat, may act on the nerve terminals or on the muscular fibres.

SYMPTOMS.—The prominent symptom of intestinal paralysis is constipation, though other signs of obstruction, such as vomiting and meteorism, may be superadded. *See* CONSTIPATION; and INTESTINAL OBSTRUCTION.

TREATMENT.—As a rule, this is directed to the primary cause, but great benefit has followed the application of electricity to the abdominal parietes. Friction applied on systematic principles is of undoubted service.

20. **Intestines, Parasites of.**—Besides the micro-organisms referred to in a previous article, there are frequently to be found in the intestines various species of animal parasites which mostly obtain their nourishment from the contents of the canal. The majority of these organisms, with the symptoms they give rise to and their treatment, are described under ENTOZOA, and are merely enumerated here collectively.

Class RHIZOPODA.—Under the name *amœba coli* are possibly included several distinct species which extended knowledge may differentiate. These animalcules have been occasionally found in healthy fæces, and more often in dysenteric stools, in dysenteric ulcers, as well as in the hepatic abscesses which so frequently complicate this malady (*see* DYSENTERY; and ENTOZOA). Various monads have been found in the stools, both in health and disease.

Class INFUSORIA.—The best known of these are *cercomonas intestinalis*, *trichomonas intestinalis*, and *paramœcium coli*. They commonly occur in diarrhœal states, which they may help to intensify, though not actually cause; and their presence may be generally taken to indicate an unhealthy state of the intestinal mucous membrane.

Class CESTODA.—Tænia mediocanellata v. saginata. T. solium. T. nana. T. cucumerina. T. flavopunctata (?). Bothriocephalus latus. B. cordatus.

Class TREMATODA.—Distoma hepaticum. D. lanceolatum. The spinous ova of bilharzia hæmatobia have been found in the mucosa and submucosa of the rectum, causing much irritation, even to the formation of polypoid overgrowths.

Class NEMATODA.—Ascaris lumbricoides. A. mystax. Oxyuris vermicularis. Ankylostoma duodenale. Tricocephalus dispar. Trichina spiralis (mature stage). Anguillula intestinalis.

Class INSECTA.—Very rarely the ova and larvæ of certain insects, chiefly of the family Muscidæ, being swallowed, are found in the canal.

21. **Intestines, Perforation and Rupture of.**—ÆTIOLOGY.—The causes of perforation or rupture of the intestines may be arranged thus: (1) *External injuries*, such as blows, being run over, &c., which, though more liable to rupture the solid abdominal viscera, frequently cause laceration of the intestines, especially the ileum or jejunum.

(2) *Corrosive poisons*, when swallowed in any considerable amount, may destroy not only the walls of the stomach, but also those of the upper part of the intestines.

(3) *Extreme distension by flatus or fæces* above the site of a constriction may cause the bowel to burst. It is the cæcum which usually gives way in chronic obstruction, a clinical fact which has received experimental confirmation.

(4) *Ulcerations*, pre-eminently the so-called peptic ulceration, and less commonly typhoid and catarrhal ulceration, may lead to intestinal perforation.

(5) *Perforations* may be produced *ab extrâ*, by the bursting of abscesses or aneurysms into the canal.

SYMPTOMS.—The most striking symptoms which perforations of the bowel present, are a sudden attack of severe abdominal pain, followed by vomiting and collapse; and it is a noticeable fact that rupture of the hollow abdominal viscera is more liable to induce this condition than a similar lesion of such organs as the liver or spleen. Rigors are of occasional occurrence at the onset, and the pulse is quickened, with sometimes a rise in temperature.

Should the patient live twenty-four hours after the establishment of a perforation, signs of peritonitis will assert themselves—severe abdominal pain and tenderness, pyrexia, vomiting, and other symptoms. Supposing that the perforation follow an ulceration in the course of a previously high temperature, such as enteric fever, there is sometimes, though not always, a sudden and considerable fall in the body-heat; this, with the acute pain, may be the first indication that perforation has taken place.

Perforation or rupture of the intestines usually proves fatal within forty-eight hours of its occurrence, although cases are recorded which have lasted for weeks; very rarely recovery has taken place.

There are no reliable signs whereby rupture of the stomach may be distinguished from that of the intestines, nor is it of any practical importance.

TREATMENT.—Rest is of primary importance, in regard both to the whole body and the bowels themselves. This object is best attained by the free use of opium, commencing with a grain, and repeating it in a few hours until its influence is fully established. It is also desirable to stop all food, except an occasional teaspoonful of meat-essence; to give ice to suck; to administer nutrient enemata, and brandy and ether subcutaneously if the collapse be profound; and to apply warmth to the extremities. Resection of the ruptured portion of the bowel, with suturing of the divided ends, and washing out of the peritoneum, has been performed with success, and should be attempted in suitable cases.

22. Intestines, Spasm of.—The irregular and forcible movements of the bowels, usually accompanied with pain, are known as *colic*. Under ordinary circumstances we are unconscious of the peristaltic action, but when the contractions of the muscular coats become violent, more or less pain is likely to occur. *See* ENTERALGIA.

ÆTIOLOGY.—The determining causes of intestinal spasm are:—

(1) The direct irritation of indigestible ingesta. (2) Exposure to cold. (3) Certain poisons, such as lead and strychnine, which probably affect the muscular fibres through the nervous system. Associated with lead colic, even if it be not actually responsible for it, is arterial spasm and high tension in the splanchnic area.

It is difficult to ascertain the exact condition of the contracted bowel, since the appearances seen after death are not an index of what existed during life; but it would seem that the spasm may start from several points in the course of the canal, and, after persisting for a variable time, either yield or travel on as a wave of spasmodic contraction. For how long a portion of bowel may remain contracted is quite conjectural.

SYMPTOMS.—The existence of an absolutely painless spasm of the intestines is very doubtful; as a rule, it is the pain which indicates this condition, and except the contraction be maintained, no further symptoms may occur. There are, however, conditions in which the tonic intestinal spasm is considerable, and yet the pain is but slight. Such is the case in basilar meningitis, where the bowels are firmly contracted and empty, producing the characteristic boat-shaped appearance of the abdomen. In many cases of chronic enteritis and colitis marked spasm may occur, causing great irregularities of the abdomen from distended and contracted lengths of bowel, with constantly varying differences in position and degree of dulness or resonance. Constipation, vomiting, meteorism, may all be present in varying degrees, dependent upon the extent of obstruction which is produced.

The specially painful spasm of the anal sphincters and lower portion of the rectum, termed *tenesmus*, is usually associated with ulceration and other lesions in that locality.

TREATMENT.—The external application of moist heat in the form of poultices or fomentations, preferably of poppy-head or other opiates, is of great value, for relaxing the spasm or removing the pain. Since an irritant is so frequently the cause, an aperient, such as castor oil or calomel, combined with opium, is essential. Turpentine enemata are sometimes of great service. The collapse may be so severe as to call for energetic stimulation by brandy, ammonia, or ether.

23. Intestines, Syphilitic Disease of. The intestinal canal is rarely the seat of the specific lesions of syphilis, except at the lower end of the rectum, and margin of the anus. Small gummata have been found in the submucous tissue of various parts of the bowel, and sometimes the ulcers to which these growths give rise by their degeneration and breaking down; radiating fibrous thickenings and cicatrices of the mucous membrane have also been seen in syphilitic subjects, sufficient even to cause obstruction. It is doubtful whether there be any specific ulceration of the intestine which is not preceded by gummata, although small ulcers do occur in new-born children, the subjects of congenital syphilis.

Syphilitic ulceration and stricture of the rectum are not of infrequent occurrence, the former especially in women, where the infection has spread from the vagina and perinæum. *See* RECTUM, Diseases of.

24. Intestines, Tubercular Disease of.—The specific lesions of the tubercular diathesis, namely, grey granulations or miliary tubercles, are of frequent occurrence throughout the intestinal canal; the extensive distribution of lymphoid tissue throughout the submucous coat, and the special aggregations of it which form the solitary and agminated glands, offering the most favourable opportunity for their formation. The abundant supply of lymphatic vessels in the thickness of the walls of the canal, and the close connexion of the serous surface with the lymphatic system, all predispose to the development and spread of a tubercular growth which may have become established in a subject of the diathesis.

ÆTIOLOGY.—As a primary growth, tubercle very rarely attacks the intestines in adults, though it is of very frequent occurrence in children as part of a general tuberculosis, or possibly from the consumption of milk from tuberculous cows. In adults, on the contrary, tubercular disease of the intestines is very commonly developed secondary to a similar affection of the lungs, due probably to the swallowing of the sputum.

ANATOMICAL CHARACTERS.—The submucous layer and the peritoneal coat are the structures in which the tubercle originates; in the former situation it especially favours the ileum and cæcum, although it may develop throughout the entire length of the tube, whilst the peritoneal tubercle is about equally distributed. The mesenteric glands are always considerably involved. The rarity with which the stomach is affected by tubercle is in marked contrast to the frequency of the intestinal lesion.

In extreme cases of tuberculosis in children, death may take place before any changes in the tuberculous formation have taken place, and countless grey granulations, from the size of a pin's head to bodies quite microscopic, are to be found in the submucosa, and in the solitary and agminated glands. Later on, however, these non-vascular new-growths coalesce, and form distinct masses, which from lack of nutrition undergo caseous degeneration and break down, thus forming the tubercular ulcers. The ulcers tend to spread, and rarely to heal, and whilst they may be at first limited to the glands, they invade the adjacent mucous membrane, especially in a direction round the bowel, their extension being preceded by the development of fresh tubercles, chiefly along the course of the main blood-vessels, to the progressive formation and destruction of which the spread of the ulcer is really due. Large masses of the mucous surface may be thus destroyed, leaving a ragged, flocculent surface, formed of the muscular fibres, or even of deeper structures, which lesions rarely proceed to perforation into the peritoneal cavity, adhesive peritonitis having established attachments to adjacent parts. The thickened, congested, irregular edges of the ulcers, with miliary tubercles close to the margin, are very distinctive.

Symptoms.—Until ulceration be established, there will be no symptoms of tubercular disease referable to the intestinal canal; and even when this stage is reached, there are no special symptoms.

Treatment.—Little can be done for intestinal tuberculosis. The course of the disease is almost invariably to a fatal end, and it is very rare for healing and cicatrisation to take place. The necessity for feeding the patient is almost contra-indicated by the existence of a destroyed digesting and absorbent surface, whereby the food becomes a positive irritant. Such nourishment as is taken should therefore be in the most digestible and concentrated form, that as much as possible may be taken up from the stomach. Starch and opium enemata may do a little to check the diarrhœa, but their efficacy is soon lost. Hæmorrhage, should it set in, is scarcely amenable to treatment, though astringent enemata may be of some use, combined with the internal administration of acetate of lead and opium. No treatment has as yet been effectual in arresting the spread of tubercle.

25. Intestines, Ulceration of.—Ulceration of the intestinal wall, from one cause or another, is of extremely common occurrence. The morbid processes involved in the production of the ulcers are in all cases essentially the same, namely, a molecular death and disintegration of the tissue, leaving a solution in continuity, of varying extent.

Varieties : (1) *Primary inflammatory ulcers.*—Any enteritis, whether of the mildest catarrhal character, or of a specific type such as diphtheritic, dysenteric, or typhoid, may lead to ulceration of the bowels. As a rule, the more severe the cause of the inflammation, the greater the liability to this complication; and the same holds in respect of any intestinal catarrh, developed in the course of any serious state, such as typhus fever or Bright's disease. The ulcer may appear either as a small abrasion of the epithelial layer, which gradually extends and deepens until the whole mucosa is involved; or the first indication may be a thin glairy pellicle, adherent to the mucous membrane which in time is thrown off, leaving a breach in the subjacent tissue. In other cases the destructive process commences in the thickness of the bowel, either from the rupture of small collections of inflammatory products, resulting from an enteritis, or from inflammation of the lymphoid follicles. The escape of these products into the tube leaves behind an ulcer.

These lesions may be found anywhere throughout the bowels, although they are much more frequent in the large than in the small intestine; and one form of follicular ulceration, associated with the specific poison of dysentery, is practically limited to the former situation. The colon is also—especially in elderly persons—the seat of a very extensive simple ulcerative colitis, in which the mucosa is destroyed over large areas, but which does not commence in the follicles. At those places where any delay is likely to arise in the passage of the fæces—the cæcum, sigmoid flexure, and rectum—and at those spots which are most prominent, such as the edges of the valvulæ conniventes, and the saccules of the colon, where an enteritis is most likely to be produced, there will be the probable site of inflammatory ulcers. The specific ulcers of dysentery and typhoid fever are described elsewhere. In cholera, ulceration of the lower end of the ileum and colon is sometimes met with.

(2) *Ulcers resulting from the separation of necrosed tissue.*—The process of molecular disintegration which takes place along the line between living and dead tissue, resulting in the separation of a slough and the leaving of an ulcer, takes place in the intestines as elsewhere. The causes leading to the death of circumscribed areas of tissue are various. Sometimes the vitality of a portion of the mucous membrane is destroyed by degeneration, such as the lardaceous, and an ulcer marks the spot of the removed patch, which usually occurs in the ileum or colon. More frequently the local death is induced by capillary hæmorrhage or a cessation of blood-flow through a limited area; the cause of this stasis is not very apparent, though believed to be due to emboli. Under such circumstances the solvent power of the digestive juices may be exerted on the non-living tissues, which are thus removed, and

an ulcer is left. To such ulcers the term *peptic* has been applied, and identical lesions are met with in the stomach. They almost invariably occur in the first part of the duodenum, above the point of entrance of the alkaline bile and pancreatic juices, although very rarely they have been seen in the jejunum. Ulcers of this character appear to be occasionally connected with large superficial burns, but how the relationship is established is not known. It is a singular fact in regard to them, that they are ten times more common in men than in women, which is quite the reverse of what obtains in the stomach, although the relative frequency of gastric and duodenal ulcers is estimated as thirty to one.

(3) *Ulceration of new-growths.*—Almost any neoplasm of the intestinal wall may ulcerate, though as a rule the more rapidly developed forms are the more liable. Tubercular growths primarily connected with the solitary and agminated glands invariably end in this manner. Syphilitic gummata and malignant growths are especially prone to ulceration.

Characters.—The appearances presented by the various ulcers differ with the cause and the duration.

They may be single, as is generally the case with the duodenal ulcers; or innumerable, as the follicular ulcers of the colon. Typhoid and tubercular ulcers are as a rule multiple, and are most numerous at the lower end of the ileum, where the agminated glands are most abundant. Occasionally large surfaces of the mucous membrane are destroyed, with here and there small isolated spots of the membrane left, due to the spread and coalescence of many separately arising ulcers. In dysentery and chronic tubercular ulceration this is especially liable to happen. Many of the catarrhal and follicular ulcers are extremely small, not more than a line in diameter.

The peptic ulcers are distinguished by their very definite, 'clean-punched' appearance; the edges are slightly sloping, and but very little, if at all, thickened; whilst the mucous membrane immediately adjacent has a perfectly healthy appearance. In most of the other varieties the edges are thickened, irregular, and shaggy, frequently excavated and undermined; the ulcerative process extending beneath the mucous membrane, which gradually dies and sloughs away as its nutrition is cut off. Dependent upon the depth and course of the ulcer will be the nature of its base, which may be formed of the muscular coat, of the peritoneum much thickened, or of adjacent structures with which adhesion has been established, such as the liver or abdominal wall. The floor of the ulcerated tubercular and malignant new-growths usually presents small nodules of the neoplasm, which are being developed coincidently with the ulceration. The buff or ash-grey pigmented sloughs, partially separated, give a characteristic appearance to the old-standing ulcers of dysentery and tubercle. The tubercular and typhoid ulcers of Peyer's patches present a certain difference in the direction in which they extend: whilst at first both are limited to the patch, the former tend to spread in an annular manner, whilst the latter have usually their long axis corresponding to the length of the bowel. This difference depends rather on the duration of the ulcer than on any specific distinction due to the two diseases; for the more acute enteric lesion rarely spreads much beyond the area of the patch, which is in the long axis of the bowel, whilst the chronic tubercular ulcer follows the distribution of the lymphoid tissue outside the patches, and particularly along the course of the blood-vessels and lymphatics.

Course.—The course of an intestinal ulcer may be acute or chronic, lasting a few days or for years. Some of the simple ulcers of an acute intestinal catarrh belong to the former group; whilst the ulceration that accompanies chronic enteritis may be of indefinite duration.

The acute forms may either heal or go on to perforation; in the former case their existence can only be inferred, and catarrhal, follicular, and enteric ulcers belong to this category. The peptic and typhoid ulcers are those most liable to perforate the bowel. Occasionally the perforation may lead to a communication between one coil of intestine and another, without any rupture into the peritoneal cavity, which is the commonest end of a perforating typhoid ulcer. In chronic ulcers, where no adhesion or communication takes place, the base is thickened by a new-formed connective tissue, which is developed as fast as or even faster than the destructive process proceeds, and hence the intestinal wall adjacent to and involved in such ulcers is usually much thickened and indurated. Short of actual perforation or adhesion to other parts, the site of the ulceration most frequently is marked on the external surface of the bowel by a sub-acute peritonitis, which may produce a partial matting together of the intestines.

In the course of the healing of the larger ulcers, by the formation of a contracting cicatricial tissue, the gut may be considerably constricted, and a formidable obstruction established. But this does not necessarily follow even large ulcers, such as those of typhoid fever; and the depth of the destruction would seem to influence this result. When the superficial portion of the mucous membrane only is destroyed very little contraction follows, but when the deeper parts of the wall are involved the subsequently developed cicatrix tends to shrink considerably.

Symptoms.—The greatest diversity is met

with in the symptoms of intestinal ulceration, and few, if any, can be regarded as characteristic. Inasmuch as the lesion may occur without producing any symptoms; or those that do exist may be determined by the course of, or by the conditions associated with, the ulceration; or, lastly, the results of this condition, such as perforation, may entirely obscure the actual ulceration itself: it frequently happens therefore that the existence of an ulcer is not recognised. Nor may the severity of the symptoms be taken as a measure of the extent of the ulceration, for the most marked pain, tenderness, diarrhœa, and other symptoms may be produced by an area of typhoid ulceration that heals; whilst a perforating duodenal ulcer may give scarcely any indication of its existence, until within a few hours of a fatal ending. This course appears to be very characteristic of duodenal ulcers. The writer has recorded a case of a young man who was suddenly attacked with all the symptoms of apparently intestinal colic, after constipation of a week's duration, no vomiting and no tenderness, the pain being relieved by pressure on the abdomen. Collapse set in, and death resulted in less than twenty-four hours from the commencement of the attack. The necropsy showed a perforating duodenal ulcer. Such a case is not singular, and may be preceded, as this case was, by nothing beyond an occasional feeling of discomfort at the epigastrium, not serious enough to call for advice or treatment.

Such symptoms as diarrhœa, vomiting, pain, tenderness, and pyrexia are as much dependent on a co-existent enteritis or new-growth, as they are upon the ulcer. Doubtless the exposed surface of an ulcer offers the opportunity for increased peristalsis being induced, but this is not of necessity, for constipation may be present. Where the area of ulceration is extensive, the absorbing surface is by so much diminished, and thus while the general nutrition suffers, the unabsorbed products of digestion are liable to decompose and induce diarrhœa. Vomiting may arise from a duodenal ulcer, but not always, and when present it may be due to peritonitis; icterus may also complicate an ulcer in this situation, by involving the opening of the bile-duct, or by extension of the duodenal catarrh. Pain may be quite absent or quite insignificant, unless the rectum be the seat of the disease, when the pain and tenesmus are excruciating.

The passage of blood in the stools, especially if bright, is probably a most characteristic indication of ulceration, but it does not always occur, and it may be due to hæmorrhoids or general venous congestion from portal obstruction. Pus is of occasional occurrence in the stools, especially when the ulceration has followed on phlegmonous enteritis or extensive follicular inflammation. Mucus is more commonly present, as discrete masses of the size of a hemp-seed or in larger quantities. In the simple ulcerative colitis already mentioned there is a singular absence of blood, pus, and mucus, thus being in marked contrast to true dysentery. *See* Stools; and Melæna.

The symptoms due to perforation have been already described. *See* Perforation and Rupture, p. 1032.

Diagnosis.—From what has been said, the formation of a diagnosis of intestinal ulceration is frequently impossible, and an ulcer is assumed rather than proved to exist. In enteric fever, ulceration is taken for granted as existing, though no special symptoms may indicate its presence. But if a severe and persistent diarrhœa, with liquid stools and shreds of mucus, and much pain and tenderness over the abdomen, supervene in a case of tubercular phthisis, it is a fair inference to assume ulceration of the intestines. In dysentery, like enteric fever, the ulceration is a specific part of the disease, and the diarrhœa, pain, and characteristic stools are in this case directly dependent upon the ulceration. Since there are no constant distinctive symptoms of ulceration, the ground for a diagnosis must remain uncertain. In distinguishing between gastric and duodenal ulcer the deferred occurrence of pain after taking food, even to two or three hours, is characteristic of the latter lesion, as well as the site of the pain being rather in the right hypochondrium, and less marked at the xiphoid cartilage and in the dorsal region, which are such frequent situations of gastric ulcer; the digestion is also much less disturbed in the duodenal affection, and hæmatemesis is much less common, being more constantly replaced by melæna. The greater frequency among males has been mentioned.

Prognosis.—This largely depends upon the cause. Except through perforation or fatal hæmorrhage by erosion of vessels, death does not take place from the ulceration itself. But a tubercular ulceration is not to be expected to heal, and it may by its development hasten the end of a phthisical patient. The prognosis of typhoid ulceration will almost entirely be founded on the general state of the patient, since the indications of the ulceration itself may be so slight. The ulceration of malignant new-growths may be of actual benefit, by removing portions of the mass, and so diminishing obstruction. In all cases the liability to stenosis must be remembered; and the impaired health of body and mind in chronic ulceration may continue throughout life.

Treatment.—Since ulcers of the intestine are inaccessible to direct treatment, little can be done for them apart from the general conditions which they may complicate, or the treatment of the symptoms to which they may give rise.

Recognising that an ulcer, when it exists, may lead to perforation, the object will be to avoid all undue movements of the intestines, and hence aperients are forbidden, and opiates are indicated. The astringents that are likely to be used for the diarrhœa or hæmorrhage may exert a local action on the lesion, and for that purpose bismuth, sulphate of copper, and similar agents are recommended. But rest is probably the only element of treatment that can affect the ulcerative process directly; whilst any improvement of the general condition will necessarily favour the healing—objects which can be best accomplished by the use of diet of the most bland description, or of nutrient enemata.

In the preceding article the diseases to which the intestines are liable have been treated of as affecting the canal as a whole; but it will be observed that when the structure and functions of particular regions of the bowel modify the character of the disease, special reference is made thereto; and, further, that when the affections of any portion require detailed description—as of the cæcum or rectum—the reader is referred to articles under those headings.

William Henry Allchin.

INTRA-THORACIC TUMOURS. Under this general term are included all growths and diseases within the chest, which give rise to tumours or swellings, offering more or less mechanical interference with the functions of the thoracic organs, and for the most part manifesting themselves by external swellings. Aneurysms would thus be comprised in this general definition. The general features and pathology of aneurysmal tumours are, however, so distinct as to require separate consideration (*see* Thoracic Aneurysm). Other intra-thoracic tumours will be found described under the headings, Lung, Malignant Disease of; and Mediastinum, Diseases of. J. Risdon Bennett.

INTUSSUSCEPTION (*intus*, within; and *suscipio*, I receive).—A form of intestinal obstruction, in which one portion of the bowel passes into another portion. *See* Intestinal Obstruction.

INUNCTION (*in*, on; and *unguo*, I anoint).—Synon.: Anointing.—This is a method of applying certain substances to the cutaneous surface, the object being to promote their absorption, either for the purpose of producing local effects, or of influencing the system generally. Inunction implies more or less energetic friction, the substance employed being rubbed with the hand or fingers into some part of the skin. When used for local purposes, the portion of surface to be anointed must be chosen accordingly; but if it is intended to affect the system, a region should be selected where the cutaneous tissues are thin, such as the inside of the thighs, or the axillæ, so that absorption may take place more rapidly and easily. The rubbing must be carried on gently, and for a variable time according to circumstances; the process may be aided by heat, inunction being performed before the fire, or the part may be previously fomented.

Application and Uses.—The pharmaceutical preparations which are employed for inunction include glycerines, liniments, oils, ointments, oleates, and compounds made with paraffins or lanoline. If these are used for local purposes, they may be employed simply on account of the oleaginous ingredients, or to allow friction to be more easily carried on; but active ingredients are often combined in the preparations mentioned, varying according to the object sought to be obtained, such as to produce a stimulant or an anodyne effect. Inunction for procuring absorption in order to affect the system, is almost entirely confined to the use of mercury, and on this subject the following observations were written for this work by the late Mr. Gascoyen:—

'Inunction is an old but very effectual plan of introducing mercury into the system by the skin. Although objected to as a dirty method, and therefore less practised than fumigation, it is often much more convenient, and can be used in many cases where the mercurial vapour is impracticable.

'From half a drachm to one drachm of strong mercurial ointment, mixed with an equal quantity of lard, should be rubbed into the skin on the inside of the thighs, legs, and arms, before a fire at bedtime, using the different limbs on successive nights. The friction should be gentle and continued for a quarter of an hour to half an hour, when most of the ointment will have disappeared; the surface must not be washed, and the patient should wear the same flannel underclothing night and day. The ointment may be used every night until the gums give evidence of its action, when the quantity and frequency of application must be diminished. Sometimes it will produce an irritation of the skin, especially in fair or hairy persons. If this occur, the surface must be washed clean, and the rubbing discontinued.

'Inunction is a most convenient way of treating syphilis in young children. The ointment should be spread upon a flannel roller, and the body of the child swathed therein; occasionally the skin should be washed, and fresh ointment applied.

'Although but little practised now in this country, inunction is still largely employed on the Continent, and particularly in conjunction with the natural sulphur waters, for cases of old-standing syphilis.'

Frederick T. Roberts.

INVAGINATION (*in*, in; and *vagina*, a sheath).—A synonym for intussusception. *See* Intussusception; and Intestinal Obstruction.

INVASION, Modes of.—This expression signifies the manner in which a disease sets in or commences, and the mode of invasion or onset of an illness is frequently an important factor in forming a diagnosis as to the nature of the complaint. The following are the variations noticed in this respect: 1. The invasion may be absolutely or almost *sudden*, although slight symptoms may have been previously observed, indicating the presence of some morbid condition, but not sufficiently marked to attract attention. Or there may be distinct indications of some disease, but a secondary lesion suddenly occurs in its course. This mode of onset is exemplified by the immediate effects of injuries, apoplexy, syncope, rupture of the heart, cholera, many cases of hæmorrhage, and most forms of colic. Certain diseases of a paroxysmal type are also characterised by the occurrence of attacks, which come on more or less suddenly, such as asthma, ague, and epilepsy. Some cases of fevers, especially typhus and relapsing fever, as well as of inflammatory diseases, begin in a sudden manner. 2. Frequently the onset is *acute*, the symptoms coming on rapidly, and becoming speedily severe, though often preceded for a variable time by premonitory symptoms. This is illustrated by most cases of the various fevers, and the different forms of acute inflammation. 3. A *subacute* mode of invasion is not uncommonly noticed, this being less rapid, and the symptoms less marked than where it is acute. 4. Most affections are *chronic* in their onset, setting in gradually, and often imperceptibly, so that it may be a long time before the patient is aware that there is any deviation from health.

Frederick T. Roberts.

IODISM.—Definition.—Iodism is the term within which we include a variety of painful and inconvenient effects, following, under certain circumstances, the administration of iodine and its salts, but more especially the iodide of potassium.

Description.—Iodide of potassium being in part, at least, decomposed in the blood, and some of the tissues to which it is carried, we shall endeavour, in considering the symptoms of iodism, to determine which are due to the iodine, and for which the potassium must be held responsible. The physiological action of iodine is mainly directed to the nutritive and glandular functions, to the skin and mucous membranes; whilst the salts of potassium are not only diuretic and purgative, but, experimentally at least, powerfully depress the heart and spinal cord.

Rilliet, the most exhaustive writer on the subject, makes three forms of iodic intoxication: the first consisting of gastric irritation; the second, where nervous troubles come into more special prominence; whilst cachexia and rapid emaciation characterise the third. But the most orderly and convenient plan to pursue will be to take into consideration, in regular order, the effects produced by iodine salts on the various organs and functions of the body, under various conditions of idiosyncrasy or retarded elimination.

1. *On the nervous system.*—Mental depression and diminution of muscular energy are not infrequently noted in patients taking iodide of potassium; whilst neuralgia, tinnitus aurium, and convulsive movements have also been described. It is possible that the potassium is here the active agent.

2. *On mucous membranes.*—Much mucous irritation is occasionally observed; conjunctivitis, lacrymation, sneezing and running from the nose, frontal headache, and puffy swelling of the eyelids, closely simulating coryza, being the most common symptoms of iodism, and sometimes following a single small or moderate dose. Pharyngeal congestion, and irritable redness of gums and tongue, have also been described. These symptoms are doubtless due to the iodine.

3. *On the skin.*—The eruptions produced by iodide of potassium have always attracted much attention, and they appear under several forms. Erythema has been observed; and most practitioners of experience must have seen the small round petechial spots, situated between the knees and ankles. These do not as a rule cause any inconvenience, and are usually accidentally discovered; but Dr. Stephen Mackenzie records the case of an infant of five months old, suffering from hereditary syphilis, who died of purpura after taking two and a half grains of iodide of potassium in a single dose. *See* Drug Eruptions.

A pustular eruption resembling acne, and sometimes so profuse as to simulate small-pox, is not very uncommon, and now and then more serious developments of skin disease may take place. Large tubercular masses may appear on the face, or a copious crop of bullæ, which occasionally burst and become converted into fungoid growths, varying in size from a pea to a shilling. All these evidences of cutaneous irritation are more likely to be produced by small than by large doses, and it is said that the frequent use of soap and the simultaneous administration of arsenic may prevent them.

4. *On the nutritive and glandular systems.*—Patients taking iodide of potassium sometimes complain of nausea, anorexia, and a bitter taste in the mouth; but where cachectic symptoms supervene, indicated by rapid emaciation, nervous palpitation, insomnia, and hypochondriasis, a ravenous desire for food has been observed. Vomiting, diarrhœa, and diuresis have also been described. Salivation is not an uncommon symptom. A time-honoured accusation

against iodine is its supposed tendency to cause atrophy of the mammæ and testicles; of this, fortunately, there is no real proof, the disappearance of the testicle, which occasionally accompanies the absorption of inflammatory products in its substance, being sometimes unjustly attributed to the treatment pursued.

Pathology.—The only reason for the occurrence of many cases of iodism seems to be an individual peculiarity on the part of the patient, or, in other words, that idiosyncrasy which so frequently interferes with our efforts for the treatment of disease. But now and then a more plausible explanation may be given, when we find cardiac or renal disease coinciding with the pustular rash of iodide of potassium. Retarded capillary circulation would naturally detain the drug within the blood; whilst the blocking of its usual means of exit from the system might be supposed to throw the onus of elimination on the glandular structures of the skin. Hence has been derived the plausible theory that iodine-acne is produced by direct local stimulation of the sebaceous structures; but, however true this may be in the slighter cases, Dr. Thin's careful examination of the skin of a patient suffering from a bullous rash has shown the true pathological condition to be one of rupture of blood-vessels at certain localised points, with blocking by coagula, and escape of some of the constituents of the blood into the surrounding tissues. The sebaceous elements and sweat-glands were quite unaffected, and he believes the iodic papule, the so-called acne, the bulla, and the purpuric spot, represent different stages of vascular injury. Sir Dyce Duckworth and Dr. Vincent Harris were unable in their observations to detect any rupture of vessels, but confirm Dr. Thin's report in all other essential respects.

Treatment.—Coryza, or any skin-eruption, suddenly occurring in a patient taking iodide of potassium, ought to be looked upon with suspicion, and treated by the immediate suspension of the drug. The slighter varieties of iodism are by no means uncommon, and may appear after a single small dose; but although ammonia has been confidently vaunted as a specific against such irregular manifestations of physiological activity, experience has been unable to confirm this, and we should place more faith in encouraging prompt elimination by very free dilution of the remedy, which is best taken on an empty stomach about half an hour before meals.

Fortunately for the reputation of one of our most useful drugs, the graver symptoms of iodism are decidedly rare; and we may all the more congratulate ourselves on this, when we remember how powerless we are to recognise the idiosyncrasy on which they depend. Trousseau, however, pointed out that iodine is always badly borne in exophthalmic goître; and Dr. Stephen Mackenzie is inclined to credit syphilis with some share in producing the purpura which proved fatal to his patient above mentioned.

Robert Farquharson.

IRELAND, South of.—*See* Queenstown. Glengariff is also deserving of notice.

IRITIS.—Inflammation of the iris. *See* Eye, and its Appendages, Diseases of.

IRREGULAR.—This term is applied to cases of disease which do not run their regular or typical course, such as gout (*see* Gout); or to functions when they are disturbed with respect to time, rhythm, or activity—as the pulse, the bowels, or menstruation.

IRRIGATION (*irrigo*, I water).—A method of applying cold water as a therapeutical agent, which consists in causing it to fall drop by drop on one spot. *See* Cold, Therapeutics of.

IRRITABILITY (*irrito*, I provoke).—In physiology this word signifies the power of responding to a stimulus, as exemplified by the contractility of muscular tissue. In medicine irritability implies an undue excitability of an organ or tissue, from disease or disorder, such as of the brain, spinal cord, stomach, eye, or bladder.

IRRITATIVE FEVER.—The nervous disturbance consequent upon fretting of the system by various sources of irritation, gives rise to a pyrexia which is often called 'Irritative Fever.' The febrile excitement so familiar to the surgeon as a consequence of wounds and injuries may be classed under this head. It may, however, be provoked by any kind of irritation, especially irritation applied to the mucous membrane of the alimentary canal. The rise of temperature which often accompanies irritation of the bowels by scybala or acrid secretions, and the febrile phenomena attendant upon dentition, may be quoted as familiar examples of irritative fever which must be within the experience of all.

The readiness with which pyrexia can be induced by these and similar causes must vary according to the intensity of the irritant, and the constitutional peculiarities of the individual upon whom it operates. As a rule, men are less susceptible than women, and women than children. In children, indeed, with their exalted nervous sensibility, feverishness from this cause is a common symptom. In young subjects mental emotion alone will often produce a rise of temperature, which may be a source of perplexity. In children's hospitals it is a common observation that the bodily temperature on the night of admission is high, even although the illness affecting the child is one not in itself usually accompanied by fever.

Dentition in young children is so frequent a cause of pyrexia, that the state of the gums should never be overlooked in any case where feverishness is a prominent symptom. Neglect of this precaution may cause some obscurity in the diagnosis. Thus, if a child, while cutting a tooth, has an attack of pulmonary catarrh, the temperature will almost certainly be high. In such a case the cough, combined with fever, rapid breathing, and a quick pulse, might naturally suggest the presence of pneumonia. On examination, however, it will be found that the pulse-respiration ratio is little perverted, the cough is loose and not hacking, there is no movement of the nares in breathing, and the history of the attack is not the history of pneumonia. On searching further for a cause of the pyrexia, tension and swelling of the gums will be noticed, and the difficulty will be at once explained.

Irritation of the stomach and bowels by acrid secretions or indigestible food is another common cause of irritative fever in children. The intense nervous disturbance excited in young babies by an improper meal induces a rapid rise of temperature, and may culminate in an attack of convulsions. Fæcal accumulation, or the irritation of worms in the bowels, may also produce sufficient disturbance to give rise to fever in children and delicate persons.

In children the sensitiveness of the system to irritants varies according to the age of the child, according to the natural impressionability of its nervous system, and also according to the state of its general health. Thus, as a rule, the younger the child, the more sensitive is its nervous system; but even in young babies differences will be found in this respect, some being affected much less easily than others by reflex stimuli. In all, however, slow reduction of the strength, such as is produced by progressive chronic disease, gradually reduces nervous sensibility; and a child, enfeebled by an illness of long standing, may show a complete insensibility to all nervous impressions. In young subjects, irritative fever, like other forms of pyrexia, is usually remittent; but its remissions are not always found at the same period of the twenty-four hours. There is not, for instance, always a fall of temperature in the morning and a rise at night. One of the peculiarities of this form of febrile disturbance is the irregularity of the fever. A high morning temperature in a young child should always suggest a reflex cause for the pyrexia.

Treatment.—The treatment of irritative fever must be directed to the relief or to the removal of the irritating sources from which the fever proceeds. The use of febrifuge remedies may be also called for, if constitutional symptoms be marked or persistent.

Eustace Smith.

ISCHÆMIA (*ἴσχω*, I restrain; and *αἷμα*, the blood).—Deficiency of blood in a part, short of complete cessation of the circulation: partial anæmia. *See* Circulation, Disorders of.

ISCHIALGIA (*ἰσχίον*, the haunch; and *ἄλγος*, pain).—A synonym for sciatica. *See* Sciatica.

ISCHL, in the Salzkammergut, Austria.—A sheltered, bracing, mild, rather moist climate. Altitude 1,560 feet. Thermal common saline baths. *See* Climate, Treatment of Disease by; and Mineral Waters.

ISCHURIA (*ἴσχω*, I restrain; and *οὖρον*, the urine).—This word properly signifies the arrest of the secretion of urine (*see* Urine, Suppression of). It is also applied to mere retention of urine.

ISSUES.—*See* Counter-irritants.

ITALY.—*See* Climate, Treatment of Disease by; and Naples; Pisa; Rome; and San Remo.

ITCH.—A popular name for scabies. *See* Scabies.

ITCHING.—*See* Pruritus.

-ITIS.—A terminal syllable used to indicate an inflammatory disease of a tissue, or organ; for example, Pleuritis, Hepatitis, or Cystitis.

J

JACTATION, or JACTITATION (*jactatio*, a tossing about of the body, or marked restlessness).—This is a condition mostly associated with certain severe febrile diseases, but also with some nervous affections, with severe pericarditis, or as a sequence of copious uterine or other hæmorrhages. A restlessness amounting to jactation may likewise be met with in some patients, when suffering from severe or long-continued pain. It must not be confounded with certain forms of chorea, in which a somewhat similar tossing about of the body may be encountered. The absence of pain and of marked febrile disturbance, together with the history of the patient, will, even in the cases where the general resemblance is closest, speedily enable the latter condition to be recognised.

JAUNDICE.—Synon.: Icterus; *Morbus Regius*; *Morbus Arquatus* (Celsus); Fr. *Ictère*; *Jaunisse*; Ger. *Gelbsucht.*

Definition.—Jaundice may be defined as a yellowness of the integuments and conjunctivæ, and of the tissues and the secretions generally, from impregnation with bile-pigment.

Ætiology and Pathology.—All cases of jaundice may be referred to one of two classes:—

I. Cases in which there is a mechanical impediment to the flow of bile into the duodenum, and where the bile is in consequence retained in the biliary passages, and thence absorbed into the blood.

II. Cases in which there is no impediment to the flow of bile from the liver into the bowel.

These two forms of jaundice have long been recognised; but there is much difference of opinion as to the mode of production of the jaundice in the second class of cases, although these are, perhaps, the most common in practice.

When there is any obstruction to the flow of bile through the hepatic or common duct, the way in which jaundice arises is sufficiently clear. The bile-ducts and the gall-bladder become distended with bile, which is absorbed into the blood by the lymphatics and the veins. If the hepatic duct of a dog be ligatured, and the animal killed after two hours, the lymphatics in the walls of the bile-ducts are seen to be distended with yellow fluid; the fluid in the thoracic duct is also yellow, and so likewise are the intervening lymphatic glands. In patients also who die of obstruction of the bile-duct, the lymphatics of the liver are often found to contain bile. On the other hand, two hours after ligature of the common duct, the serum of blood taken from the hepatic vein contains much more bile-pigment than that of blood taken from the jugular vein, which shows that in cases of obstruction of the bile-duct, bile is also directly absorbed by the veins.

But in a large proportion of cases there is no mechanical impediment to the escape of bile from the liver, and then an explanation of the jaundice is less obvious. Boerhaave and Morgagni long ago suggested that the jaundice in these cases was the result of a *suspended secretion.* They taught that the function of the liver was merely to separate the elements of bile which were already formed in the blood; and that when anything interfered with the function of the liver, the elements of bile accumulated in the blood, and the result was jaundice of the skin and other tissues. Although this view has been strenuously opposed by several excellent authorities, it was in this country until recently generally accepted. It was advocated, for example, by Dr. George Budd, in his valuable treatise on diseases of the liver, although it is but right to add that Dr. Budd made a special exception with regard to the biliary acids. 'The most skilful chemists,' he says, 'who have recently analysed the portal blood, have failed to detect the biliary acids in it, and have come to the conclusion that these at least are formed in the liver.' This opinion, that the liver manufactures the bile-acids, while it merely excretes the bile-pigment, was adopted by Dr. G. Harley, in his essay on jaundice.

There are, however, weighty objections to this view, some of which may be mentioned.

1. Although bile-pigment appears to be derived from the colouring matter of the blood, it has not yet been satisfactorily shown that bile-pigment, as such, exists ready formed in the blood of persons who have not jaundice. Frerichs denies that it ever has existed. Lehmann, who has investigated with great care the changes which the blood undergoes in passing through the liver, has never been able to detect the colouring matter of bile in portal blood, and infers that this, as well as the bile-acids, must be formed in the liver itself. The blood of the hepatic artery has been examined with a like result. It is obvious that if bile-pigment exists in healthy blood at all, its quantity must be very minute; and when we consider that the quantity of bile secreted by the human liver daily is about two pints, and yet that jaundice is not a normal condition, it seems impossible that all the bile-pigment secreted by the liver can be formed in the blood, and it is not probable that part is formed in the blood and part in the liver. The discovery by a few observers of a small quantity of bile-pigment in what appeared normal blood does not prove that it was formed in the blood. It is quite conceivable that it may have been formed in the liver, and have become subsequently absorbed.

2. The secreting tissue of the liver is often for the most part or entirely destroyed, so that bile is no longer secreted, and yet no jaundice results. If bile-pigment be formed in the circulating blood, it is difficult to explain what becomes of it in these cases.

3. If the constituents of bile are formed in the blood, intense jaundice ought at once to follow the extirpation of the liver in any of the lower animals, in like manner as urea accumulates in the blood after removal of the kidneys. But Müller, Kunde, Lehmann, and Moleschott have repeatedly extirpated the liver of frogs, and have invariably failed to find a trace of the biliary acids, or of bile-

pigment, in the blood, the urine, or the muscular tissue. Whether the same would hold good as regards man is questionable.

These and other considerations make it very doubtful if any case of jaundice can with propriety be attributed to a suppression of the hepatic functions; and it is therefore necessary to seek for some other explanation of those cases of jaundice in which there is no obstruction in the bile-duct.

A solution of the difficulty has been proposed by Professor Frerichs, of Berlin. According to this distinguished observer, a large proportion of the colourless bile-acids formed in the liver is either directly taken up by the blood in the hepatic vein, or is absorbed from the bowel. Under ordinary circumstances, these bile-acids become oxidised and assist in forming the large quantity of taurin found in healthy lung, and the pigments voided in the urine; but if these normal metamorphoses are interrupted by nervous agencies, or by poisons in the blood, the bile-acids, not being sufficiently oxidised, are converted into bile-pigment in the blood, and the result is jaundice. This view seemed to to be supported by two experiments intended to show—first, that bile-pigment can be produced artificially from the bile-acids, by the action of concentrated sulphuric acid; and, secondly, that colourless biliary acids, when injected into the veins of dogs, are converted in the blood of these animals into bile-pigment. There is, however, far from being unanimity among different observers as to the results of these experiments; and it has more recently been proved that bile-acids are not, either in or outside the body, converted into bile-pigment. The bile-acids probably act by liberating the hæmoglobin from the red corpuscles, and the dissolved hæmoglobin is converted by the liver-cells into bilirubin. A decision of the points at issue does not appear to be of material importance for explaining those cases of jaundice in which there is no obstruction of the bile-duct, inasmuch as there are good grounds for believing that not only in jaundice, but in health, a portion of the bile-pigment, as well as of the bile-acids, formed in the liver, is absorbed into the blood.

Although the amount of bile secreted daily must vary in different persons, and in the same person under different circumstances, being modified by the quantity and quality of the food, the activity of respiration, and other conditions, there can be little doubt that but a small portion of that which is ordinarily secreted is discharged from the bowel. Observations on the lower animals and on man himself have shown that the quantity of bile secreted by the liver of a healthy adult averages forty ounces. It is generally admitted that the fæces contain but a fraction of the bile-acids (altered) corresponding to this quantity of bile, and it seems equally clear that much of the bile-pigment must also disappear in the bowel. There are grounds for believing that the bile-pigment which so disappears goes to form urinary pigment; while the fact familiar to all clinical observers, that the bile-pigment discharged from the bowel is greatly increased by calomel and other purgatives, without any corresponding increase of secretion of bile by the liver, seems to show that under ordinary circumstances much of the bile-pigment secreted by the liver is not discharged with the fæces. It may be added that in carnivorous animals and in snakes, although bile-pigment is secreted in abundance by the liver, the quantity discharged with the fæces is even relatively less than in man.

The question as to what becomes of the bile which is not discharged from the bowel has an important bearing on the pathology of the cases of jaundice now under consideration. A large proportion of it is again absorbed, either by the biliary passages, or by the mucous membrane of the bowel. From what is now known of the diffusibility of fluids through animal membranes, it is impossible to conceive bile long in contact with the lining membrane of the gall-bladder, bile-ducts, and intestine, without a large portion of it passing into the circulating blood. The constant secretion and reabsorption of bile is, in fact, merely part of that osmotic circulation constantly taking place between the fluid contents of the bowel and the blood, the existence of which is too little heeded in our pathological speculations and in therapeutics. The quantity of fluid which is being thus constantly poured out from the gastric and intestinal glands, the liver, pancreas, &c., and then reabsorbed, is enormous; in twenty-four hours it probably far exceeds the whole amount of blood and fluid in the body. The effect of this continual outpouring is supposed to be to aid metamorphosis; the same substance, more or less changed, seems to be thrown out and reabsorbed, until it is adapted for the repair of tissue or becomes effete. How many times this cycle of movement is repeated, before the bile is extruded from the system, we have no means of knowing; but in the course of this osmotic circulation, much of the bile appears to become transformed into products which are eliminated by the lungs and kidneys, while at the same time this circulation assists in the assimilation of the nutritive materials derived from the food.

Here, then, we have an explanation of those cases of jaundice where there is no impediment to the flow of bile from the liver. Under normal conditions, the whole of the bile that is secreted is at once transformed, so that neither bile-acids nor bile-pigment can be discovered in the blood or in the urine, and there is no jaundice. But in certain morbid states the absorbed bile does not undergo the normal metamorphoses; it circulates in the blood and stains the skin and other tissues, and in this way we have jaundice without any obstruction of the bile-duct. The morbid states which, so far as we know, conduce mainly to this result are, for the most part, precisely those in which we might expect abnormal blood-metamorphoses, namely:—

1. Certain poisons, such as those of yellow fever, relapsing fever, pyæmia, and more rarely those of remittent fever, typhus, and scarlatina; also snake-poison, chloroform, &c.

2. Nervous influences, such as a sudden fright, violent rage, great or protracted anxiety, and concussion of the brain.

3. A deficient supply of oxygen, as happens in certain cases of pneumonia, or in persons living in confined and crowded dwellings.

4. An excessive secretion of bile, especially when conjoined with constipation. In this case, unless the bile be removed by purging, the quantity absorbed may be too great to undergo the normal metamorphoses, and the presence in the blood of the untransformed bile causes jaundice.

According to this view, the only pathological difference between jaundice from obstruction and jaundice independent of obstruction of the common bile-duct is that, in the former case, little or none of the bile secreted by the liver can escape from the body with the fæces, and consequently all that is secreted is absorbed into the blood, and the quantity thus absorbed is far too great to undergo the normal metamorphoses; while, in the latter case, bile passes into, and is discharged from the bowel, as usual, but that which is absorbed, which in quantity may not exceed what is absorbed in health, remains unchanged in the blood. As might be expected, the jaundice in the former case is usually much more intense than in the latter, although, when an obstruction of the bile-duct has lasted long, the jaundice often becomes paler, not from any diminution of the obstruction, but from the secreting tissue of the liver becoming destroyed, and comparatively little bile being secreted; while in cases where there is no obstruction of the bile-duct, the intensity of the jaundice will vary according to the amount of bile which is absorbed, and the degree of derangement of the blood-metamorphosis.

Jaundice is by some writers divided into *hepatoginous* and *hæmatoginous* jaundice. In obstruction of the ducts the jaundice is clearly hepatoginous. Regarding hæmatoginous jaundice there is considerable dispute. In various diseases (*e.g.* acute atrophy of liver, yellow fever, remittent fever, and occasionally typhus and relapsing fever, &c.), and as the result of certain poisons (*e.g.* snake-bite, phosphorus, arsenic, and antimony), in which there is no apparent obstruction of the ducts, jaundice occurs, and at the same time there is evidence of blood-destruction. How the latter brings about the jaundice has been very carefully worked out experimentally by Stadelmann in regard to the action of toluylendiamine in dogs, cats, and rabbits. Briefly put, the effect of this poison is to act powerfully on the red corpuscles, so that they part too readily with their hæmoglobin. The latter is acted upon by the liver, and converted into bile. The pigment and acids are increased; and if the action is continued, the bile becomes so inspissated that it blocks the small ducts, increases the pressure in the biliary canaliculi, and leads to absorption. Thus, what at first sight appears to be, and is in a certain sense, a hæmatoginous jaundice is in fact a hepatoginous jaundice, due to absorption. What is proved with regard to toluylendiamine is probably true with regard to mineral, vegetable, and animal poisons. After transfusion of blood from one animal to another of different species, a dissolution of the foreign blood-corpuscles takes place, and hæmoglobinæmia results. Much of the blood-pigment is eliminated by the kidneys, causing hæmoglobinuria; but some reaches the liver, causing an increase of bile-pigment, which is absorbed and gives rise to a slight degree of jaundice. The same has been observed in some malarial affections, in which both hæmoglobin and bile are present in the urine—malarial hæmoglobinuria. On the other hand, in old extravasations of blood, after a time, disintegration of the blood-corpuscles takes place, and hæmatoidin, which is regarded by many modern chemists as identical with bilirubin, results. The hæmatoidin is absorbed and stains the tissues, and appears in the urine as bile-pigment. What is proved as regards extravasations may occur in smaller blood-disintegrations, and thus the possibility of a true hæmatoginous jaundice cannot be denied, though it has not been actually proved except in the case of old extravasations. Speaking generally, *hepatoginous* jaundice corresponds with obstructive, and *hæmatoginous* jaundice with non-obstructive jaundice. In acute yellow atrophy there is no obstruction. The jaundice is ascribed by some to arrest of the bile-producing functions of the liver-cells, by others to blood-destruction. If the arrest of bile-production in the liver was complete, it is clear that the bile, which in this disease stains the tissues and appears in the urine, must be produced elsewhere, and be hæmatoginous, or at least extra-hepatic. It is possible that the absorption of bile-acids in obstructive jaundice exercises a destructive influence on the red corpuscles, and thus becomes an additional source of bile-pigment. Niemeyer particularly insisted that 'every hepatoginous icterus tends to become an hæmatoginous icterus.'

With these preliminary remarks on the

pathology of jaundice, we may now proceed to enumerate its different causes, which may be classified according to the following tabular form:—

A. **Jaundice from Mechanical Obstruction of the Bile-duct.**

I. *Obstruction by foreign bodies within the duct.*

1. Gall-stones and inspissated bile.
2. Hydatids and distomata.
3. Foreign bodies from the intestines.

II. *Obstruction by inflammatory tumefaction of the duodenum, or of the lining membrane of the duct, with exudation into its interior.*

III. *Obstruction by stricture or obliteration of the duct.*

1. Congenital deficiency of the duct.
2. Stricture from perihepatitis.
3. Closure of the orifice of the duct in consequence of an ulcer in the duodenum.
4. Stricture from cicatrisation of ulcers in the bile-ducts.
5. Spasmodic stricture.

IV. *Obstruction by tumours closing the orifice of the duct, or growing in its interior.*

V. *Obstruction by pressure on the duct from without, by*—

1. Tumours projecting from the liver itself.
2. Enlarged glands in the fissure of the liver.
3. Tumour of the stomach.
4. Tumour of the duodenum or pancreas.
5. Tumour of the kidney.
6. Post-peritoneal, or omental tumour.
7. An abdominal aneurysm.
8. Accumulation of fæces in the bowels.
9. A pregnant uterus.
10. Ovarian and uterine tumours.

B. **Jaundice independent of Mechanical Obstruction of the Bile-duct.**

I. *Poisons in the blood interfering with the normal metamorphosis of bile.*

1. The poisons of the various specific fevers. (*a*) Yellow fever; (*b*) Remittent and intermittent fevers; (*c*) Relapsing fever; (*d*) Typhus; (*e*) Enteric fever; (*f*) Scarlatina; (*g*) Epidemic jaundice.
2. Animal Poisons: (*a*) Pyæmia; (*b*) Snake-poison.
3. Mineral poisons: (*a*) Phosphorus; (*b*) Mercury; (*c*) Copper; (*d*) Antimony; (*e*) Arsenic.
4. Chloroform and ether.
5. Acute atrophy of the liver.?

II. *Impaired or deranged innervation interfering with the normal metamorphosis of bile.*

1. Severe mental emotions, fright, anxiety, and allied causes.
2. Concussion of the brain.

III. *Deficient oxygenation of the blood, interfering with the normal metamorphosis of bile.*

IV. *Excessive secretion of bile, more of which is absorbed than can undergo the normal metamorphosis.*

1. Congestion of the liver: (*a*) Mechanical; (*b*) Active; (*c*) Passive.

V. *Undue absorption of bile into the blood, from habitual or protracted constipation.*

Symptoms.—From what has been stated in the preceding section, it is obvious that jaundice is not a disease, but is a symptom of many different diseases. This view of the matter cannot be too strongly impressed upon the student and practitioner, whose efforts in every case must be directed to discover the fundamental malady. There are, however, certain phenomena connected with jaundice, independent of its cause, which deserve to be mentioned.

1. *Intensity of the jaundice.*—Next to the liver itself, the skin is the tissue of the body which becomes most deeply jaundiced; but before it becomes affected, a yellow tint is usually observed in the conjunctivæ. There must be a certain concentration of bile-pigment to produce a yellow colour of the skin; in the slighter and more temporary cases, the conjunctivæ only may be affected. Although after ligature of the common bile-duct in the lower animals it has been sometimes found that even the conjunctivæ do not become jaundiced for two or three days, in the human subject jaundice of both skin and conjunctivæ is usually observed within twenty-four hours of closure of the duct.

The colour of the skin varies from a pale sulphur or lemon-yellow, through a citron yellow, to a deep olive or bronzed hue. The tint varies according to the cause and its duration. When the cause is obstruction of the bile-duct, it is light at first, and increases in depth the longer the disease lasts; although in advanced cases, as already stated, the colour sometimes becomes pale, not from the obstruction yielding, but from the tissue of the liver becoming destroyed, and very little bile being secreted. In jaundice from obstruction also the depth of tint often varies from day to day, not from any variation in the degree of obstruction, but according to the amount of bile secreted by the liver, and the eliminative activity of the kidneys. It is well to remember that what is called 'black jaundice' may result from any cause of obstruction—from gall-stone as well as from cancer. In these cases the greenish or almost black hue is due to the absorbed bile-pigment being vitiated and dark, or to the visage being also darkened from imperfect arterialisation of the blood, the dark colour resulting from a mingling of the lividity with the colour of bile. When the jaundice is independent of obstruction to the flow of bile, the colour is rarely very deep, and yet these are often the most serious cases. The colour also varies with the age, the natural complexion, and the amount of fat in the individual. It is deeper in the old, the wrinkled, and the dark-complexioned, than in young persons of fair complexion, and with plenty of fat. Lastly, it is important to remember that the colour often remains in the skin for some time after the cause of the jaundice has been removed, and that then its departure may be expedited by diaphoretics and warm baths.

2. The *secretions* are tinged with bile-pigment, but some much more so than others. This is notably the case with the urine, by which the greater part of the bile-pigment is eliminated from the body, and which acquires a saffron-yellow, greenish-brown, or brownish-black hue, according to the amount of pigment which it contains. The urine usually becomes yellow before the skin, or even the conjunctivæ; and when the cause of the jaundice is transient, it may happen that the whole of the pigment is eliminated by the urine, without any jaundice appearing in the skin. On the other hand, when once the skin has become yellow, it may remain so for some time after bile-pigment has quite or nearly disappeared from the urine.

Other secretions may contain bile-pigment as well as the urine. The cutaneous glands sometimes eliminate it in such quantity as to stain the linen yellow, but the amount discharged in this way is never great. Instances have been recorded where the secretion of the mammary glands has been tinged with bile-pigment, but they are not very common. Still rarer instances have been noticed where the saliva or the tears have been tinged. It is not a little remarkable that bile-pigment is not eliminated in cases of jaundice by the mucous membrane of the respiratory passages, or of the digestive tube. This is a matter of some practical importance, for, were it otherwise, the stools might contain bile-pigment even when there was complete obstruction of the gall-duct. Still, when either of these mucous membranes is inflamed, and throws off an albuminous or fibrinous exudation, the altered secretions may contain bile-pigment. Thus, when pneumonia coexists with jaundice, there is often bile-pigment in the sputa, which may be distinguished by the nitric-acid test from the greenish or yellow colour often presented by pneumonic sputa owing to changes in the blood-pigment independent of bile. Indeed, in cases of jaundice bile-pigment may be detected in inflammatory exudations, as in the serum of a blister, before it appears either in the skin or even in the urine. It is probable that those rare cases where the saliva has been noticed to be yellow admit of a similar explanation; in many of them there has been mercurial salivation, a condition in which the saliva is not normal, but contains much albumen.

3. A *bitter taste* is not infrequently complained of by persons who are the subjects of jaundice. It may denote the presence in the blood of the biliary acids, for taurocholic acid is intensely bitter. It is at all events not due to bile-pigments, which are tasteless. Moreover, it is a common symptom in biliary derangements where there is no jaundice.

4. *Derangements of digestion*, such as flatulence, constipation, and an altered character of the motions, may be due to the absence of bile from the motions. Bile is an antiseptic, though a very feeble one, and when it is absent the intestinal contents undergo fermentation, gases accumulate in the bowels, the motions become putrid, and from the absence of bile and the presence of fat they present a pale-drab or clay colour. Bile is also the natural stimulant of the peristaltic action of the gut, and consequently, when the supply is cut off, the bowels are usually constipated; but in some cases the putrid fæces act as an irritant and excite diarrhœa. In those cases of jaundice where there is no obstruction of the common bile-duct, the motions may be but little altered.

When bile does not enter the bowel, the digestion of fat is interfered with. Jaundiced patients dislike fat, and do not assimilate it, and the fatty matter in the ingesta may sometimes be detected in the stools. Hence, whatever be the cause of obstruction of the bile-duct, the nutrition of the body suffers: the emaciation may be slow, but it is progressive, until all the fat disappears, and then the weight of the body may remain stationary for many months. With the emaciation there is always more or less muscular debility.

5. *Pruritus*, without any eruption, is a very obstinate and distressing symptom in many cases of jaundice. It is usually worse at night, and, by preventing sleep, may wear out the patient. It is chiefly observed in cases of jaundice due to obstruction of the bile-duct. It is not due to the presence of bile-pigment in the blood, for in some cases it precedes the jaundice, and in others it comes and goes during the persistence of the jaundice. Moreover, in many cases of jaundice it is absent throughout, while it is not uncommon in biliary derangements where there is no jaundice.

6. *Cutaneous eruptions.*—Urticaria, lichen, boils, or carbuncles are occasionally observed in connexion with jaundice; and likewise that remarkable affection of the skin known as *xanthoma*, *xanthelasma*, or *vitiligoidea*. *See* XANTHELASMA.

7. The *temperature* is not altered in jaundice, except when this occurs as a complication of some acute febrile disease, or when there is inflammatory action in the liver itself.

8. *Slowness of pulse.*—A common result of non-febrile jaundice is retardation of the

heart's action, and diminution of arterial tension. The pulse may fall to 50, 40, or even 20, and sometimes it is also irregular. This slowness of pulse is particularly noticeable when the patient is recumbent. When there has been antecedent pyrexia, the pulse usually falls on the supervention of jaundice. Slowness and irregularity of the pulse are chiefly observed in jaundice from obstruction of the bile-duct, and particularly in those common cases known as catarrhal jaundice; and accordingly they are not unfavourable symptoms, as might have been supposed. So far as the writers' experience goes, patients with this symptom invariably recover. It has not yet been explained why this condition of circulation should be present in some cases of jaundice, and absent in others. The natural explanation would be that it is due to some ingredient of the bile, which does not exist in the blood in all cases of jaundice. Some experiments of Röhrig have shown that the biliary-acid salts paralyse the heart, and retard its action, while bile-pigment has no such effect. It has been shown by Dr. Wickham Legg and others that the slowing of the heart is due to the action of cholalic acid on the cardiac ganglia. Slowness of the pulse, therefore, in jaundice may indicate the presence in the blood of unchanged biliary acids; but so far there are no observations to show that bile-acids are present in the urine in these more than in other cases of jaundice.

9. *Hæmorrhages.*—In many cases of jaundice the blood seems to become impoverished, by a diminution in the proportion of red corpuscles and fibrin; and hæmorrhages take place from the various mucous membranes and into the substance of the skin. This hæmorrhagic tendency is particularly observed, in conjunction with cerebral symptoms, in cases of jaundice where there is no obstruction of the bile-duct; but it also occurs in cases of mechanical jaundice of long standing, from any cause, when the secreting tissue of the liver has in a great measure disappeared.

10. *Xanthopsy* or *Yellow vision.*—In rare cases of jaundice, all white objects appear yellow to the patient. The administration of santonin internally has also sometimes been followed by yellow vision, which has ceased as soon as the colouring-matter has been eliminated by the kidneys. This fact, as well as the observation that in several cases of jaundice, with xanthopsy, the conjunctival vessels have been preternaturally distended with blood, has led to the belief that the symptom is due to a tinging with bile-pigment of the humours of the eye. On the other hand, the circumstances that the xanthopsy may intermit, without any change in the jaundice; that it is usually absent when there is intense jaundice of the cornea and other tissues of the eye; and the statement that it may occur in typhus fever, and in certain derangements of vision, such as night-blindness, when there is no jaundice, have led most authorities to consider it, as appears to have been proved in regard to the effects of santonin, as due to an affection of the visual nerves.

11. *Cerebral symptoms, and the Typhoid state.*—Patients with jaundice are often irritable in their temper and hypochondriacal; and occasionally they are attacked with acute delirium, stupor, coma, convulsions, muscular tremors, subsultus, carphology, paralysis of the sphincters, a dry and brown tongue, and other indications of the typhoid state. These symptoms are most common in cases where there is no obstruction of the ducts, but they also occur in cases of obstruction, usually of long standing, where all or the greater part of the secreting tissue of the liver has been destroyed. Different opinions are held as to their cause. After death no lesion is found of the brain or its membranes, and they are, therefore, most probably due to some alteration of the blood. They are commonly attributed to poisoning of the blood with bile, either from suppression or reabsorption of the secretion. But the assumption that the elements of the bile are preformed in the blood has been already shown to be probably erroneous; and there is equally little evidence that absorbed bile is possessed of poisonous qualities, or that its presence in the blood, even to saturation, will give rise to cerebral symptoms. Many experiments have been performed on animals to show that bile is a deadly poison; but there is reason for believing that the bad results observed have been due to the injection into the areolar tissue of decomposing mucus contained in the bile. Bile, from which the mucus has been removed, has been repeatedly injected by Frerichs and other observers into the large veins of dogs, without cerebral symptoms or any bad results ensuing, except that death has in some instances been caused by the entrance of air into the veins. But it is scarcely necessary to turn to experimental inquiries on the lower animals for evidence on the matter, and in all these experiments there are sources of fallacy. There is ample proof that the blood of the human subject may be saturated with bile for months, or even years, without any cerebral symptoms resulting. Dr. Austin Flint, jun., is of opinion that the cerebral symptoms of jaundice are due to the retention of cholesterin in the blood, or to what he has designated *cholesteræmia.* Cholesterin is one of the constituents of bile, and Dr. Flint regards it as an excrementitious product of nervous tissue, the elimination of which from the body is one of the functions of the liver, and the retention of which in the blood he believes to act as a poison like urea. But if the non-excretion of all the elements of bile does not give rise to cerebral symp-

toms, it is difficult to understand how they can result from the retention of cholesterin alone. In cases, for instance, of permanent closure of the bile-duct, cholesterin is not discharged from the liver into the bowel, nor does it accumulate in the biliary passages, and yet, if it be retained in the blood, cerebral symptoms rarely occur.

The cerebral symptoms in jaundice are often most severe when the jaundice is slight, and they may occur in diseases of the liver when there is no jaundice. They are best explained by the knowledge which we now possess of the function performed by the liver in disintegrating albuminous matter into less complex substances, such as urea and uric acid, which are eliminated by the kidneys. When this function of the liver is arrested or seriously impaired, urea is no longer eliminated in sufficient quantity by the kidneys; lithic acid and deleterious products of disintegrating albumen even less oxidised, such as leucin and tyrosin, and perhaps others with which we are as yet imperfectly acquainted, accumulate in the blood and tissues; the result is the development of symptoms of blood-poisoning similar to those which arise when the kidneys are unable to eliminate the products of albumen-disintegration, owing to disease of their own structure, or to an excessive formation of urea and other products, as happens in many febrile diseases. In acute atrophy, for example, the structure of the liver is destroyed, and its functions are arrested; leucin and tyrosin take the place of urea in the urine, and are also found in large quantity in the liver, spleen, and kidneys; while cerebral symptoms and the typhoid state are prominent features of the disease. *See* CHOLÆMIA.

DIAGNOSIS.—There is rarely much difficulty in the diagnosis of jaundice, but it is well to remember that certain conditions are sometimes mistaken for it. Such are chlorosis, pernicious anæmia, hæmoglobinuria, the anæmic aspect resulting from organic visceral disease (and particularly from contracted kidneys), from cancer, from exposure to malaria, from Addison's disease, or from lead-poisoning; an undue amount of sub-conjunctival fat; or an unusually dark colour of the ordinary urinary pigment, or the presence in the urine of abnormal pigments, such as those of santonin, turmeric, rhubarb, &c. In every case where there is the slightest doubt, it will be removed by resorting to the nitric-acid test for bile-pigment in the urine. If this gives no result, the case is not one of jaundice.

But it is a more difficult matter to determine the cause of the jaundice, and yet this should invariably be the aim of the medical attendant, before forming a prognosis or proceeding to treatment. The scope of this article does not permit a lengthened analysis of the characters distinguishing the different forms of jaundice according to its cause, but the following remarks may be of some service.

1. In the first place it is always well to determine whether or not the jaundice be due to obstruction of the bile-duct. According to Dr. G. Harley, this can be done by determining the presence or absence of bile-acids in the urine. Adopting the view that bile-acids are formed by the liver, while bile-pigment is preformed in the blood, he contends that in jaundice from 'suppression' (or independent of obstruction) the liver does not secrete bile, and consequently, no bile-acids being formed, none can enter the circulation or be detected in the urine; whereas in jaundice from obstruction, bile is secreted and absorbed into the blood, and a portion of the bile-acids not transformed in the circulation appears in the urine. But in addition to the strong improbability already urged that any form of jaundice is due to a *suppressed secretion* of bile, clinical experience is entirely opposed to the practical value of the test in question for throwing light on the cause of jaundice. Bile-acids have been found in the urine in cases of acute atrophy of the liver, where there is no obstruction of the bile-duct, and in very many cases of mechanical jaundice they are certainly absent. The ordinary clinical test for bile-acids in the urine (Pettenkofer's) is a very uncertain one. For more accurate methods, *see* Halliburton's *Text-book of Chemical Physiology and Pathology.* A more reliable indication of obstruction of the common bile-duct is furnished by the stools. When there is no obstruction, the stools almost invariably contain bile; but when the duct is obstructed they are clay-coloured. The rule is not without exceptions, and there are several sources of fallacy. The jaundice usually persists for some time after the duct has become pervious, and thus bilious motions may co-exist with jaundice which has resulted from obstruction; or, if the motions be thin and watery, they may appear to contain bile from the admixture of jaundiced urine; or, not infrequently, when the bile-duct is quite impervious, the motions are of a brownish tinge, owing to the presence of altered blood, which may closely resemble dark bile. Iron, bismuth, and charcoal also colour the motions. A tumour corresponding to the region of the gall-bladder will favour the view that jaundice is due to obstruction of the bile-duct. Lastly, jaundice which persists and is yet slight, is most probably independent of obstruction, for jaundice from persistent obstruction speedily becomes intense.

2. It is always important to note the mode of commencement of jaundice. That which appears suddenly in a person whose previous health has been good, is most probably the result of obstruction of the duct by a foreign body, or it has a nervous origin. The former cause will be distinguished by biliary colic, vomiting, and clay-coloured stools. On the

other hand, jaundice coming on slowly, but ultimately becoming intense, with clay-coloured stools, points to pressure on the duct from without, or to a growth in its interior.

3. A history of previous attacks of jaundice of a similar nature is in favour of a catarrhal origin, or of gall-stones.

4. Pain in severe paroxysms concurring with jaundice points generally to gall-stones or cancer; more rarely to hydatids, or to an aneurysm of the hepatic artery. Cancer is distinguished from gall-stones by there being usually a history of failing health and emaciation before either the pain or the jaundice.

5. Jaundice concurring with enlargement of the liver is most probably due to cancer or cirrhosis; more rarely to pyæmic abscesses, or to waxy liver with large glands in the portal fissure.

6. Jaundice concurring with ascites points to cancer or cirrhosis. The diagnosis of the latter will usually be assisted by the physiognomy, the slightness of the jaundice, the previous habits, and a history of alcoholic dyspepsia; while in cancer there are often darting pains, and the jaundice is usually intense.

7. Jaundice concurring with pyrexia is either secondary to some acute febrile disease; or is due to suppurative pylephlebitis, a suppurating hydatid tumour opening into a bile-duct, or inflammation of the bile-ducts. Temporary pyrexia may also occur during the passage of a gall-stone.

8. Cerebral symptoms associated with jaundice suggest acute atrophy of the liver, poisoning by phosphorus, some specific fever, pneumonia, or nervous shock.

9. Jaundice in a young person, preceded by symptoms of gastric catarrh, is most probably catarrhal.

TREATMENT.—There is no special treatment for jaundice; in all cases the treatment must have reference to what is believed to be its cause. The appropriate treatment will therefore be discussed under the head of the several diseases which give rise to it. In a considerable proportion of cases, however, it is impossible to determine the precise nature in the first instance, and pending an exact diagnosis we are obliged to adopt some provisional treatment. Treatment should in no case be neglected, for what may appear to be a trivial jaundice may prove in the sequel to be an early stage of acute atrophy of the liver. There are therefore certain general rules of management which may be laid down. There is no need that the patient should be confined to bed, unless other symptoms indicate such necessity; moderate exercise may be allowed even in the open air, provided the patient is suitably clothed. The clothing should be warm, but light. The food should be simple and nutritious. There is no need to rigidly exclude fatty and saccharine matter, but no excess should be allowed, and pastry should be avoided. Alcoholic beverages, especially fermented liquors, should be withheld. In some cases of long-continued jaundice considerable quantities of flesh are required, and are digested, to supply the fatty matter lost to the system by the absence of bile in the intestine. Milk is usually well borne, and supplies fat in an emulsified form. The patient should be encouraged to freely drink warm fluids or the natural alkaline waters, as those of Vichy, as the kidneys are the chief eliminators of bile. Warm baths should be used, and occasionally the Turkish bath is of service. At the commencement of an attack a dose of calomel or blue pill (gr. ij.) in combination with colocynth or rhubarb pill, followed by a saline aperient draught on the following morning, may be administered. Mercurials should be cautiously used as long as an uncertainty as to the exact nature of the case remains, but the evil effects of mercury have been exaggerated, and it has been determined that it diminishes, and not increases, the secretion of bile. An alkaline and bitter stomachic is often of much service, especially when the tongue is coated; 20 grains of bicarbonate of potassium or sodium, with 20 minims each of aromatic spirit of ammonia and spirit of chloroform, 5 minims of tincture of nux vomica, in an ounce of some bitter infusion, as calumba, gentian, cascarilla, or chiretta, recently prepared, may be given three times a day between meals. In some cases, when the tongue is clean, or has been cleaned by an alkali, acids appear to do good; 10 to 20 minims of diluted nitro-hydrochloric acid in an ounce of a bitter infusion should be given half an hour before meals, and taraxacum may be usefully added—20 grains of the extract, or a drachm of the succus. Aperients are in many cases required, and in most cases useful. They have the effect of lessening portal congestion, and replace the natural purgative quality of the bile. Saline aperients as a rule answer best. A drachm of Carlsbad salt in a tumblerful of warm water, or half a tumblerful of Carlsbad water, to which some hot water has been added, should be taken before breakfast, and its efficacy is increased if it is *sipped* instead of being taken at a draught. Another useful saline aperient is phosphate of sodium, a drachm three times a day in a bitter infusion. In some cases vegetable aperients answer, when colocynth, aloes, rhubarb, or cascara may be given. When diarrhœa is present, salicylate of bismuth (gr. x.), or oil of turpentine (♏x. to xx.) in capsules, on an empty stomach, should be tried. When jaundice is not due to an insuperable obstruction, euonymin, iridin, podophyllin, and other hepatic stimulants, are sometimes useful; and when there is gastro-duodenal catarrh, ipecacuanha is often of much service. The following is a good formula: ℞ Euonymin gr. jss., iridin gr. j., ipecacuanhæ gr. $\frac{1}{4}$, pilulæ colocynthidis et hyoscyami gr. ij.; ft. pil.; one to be taken every or every other night. For flatulence, which often is troublesome, carbolic acid, creasote, menthol, and turpentine are useful. The following pill may be employed: ℞ Aloin gr. $\frac{1}{2}$, acidi carbolici (seu menthol) gr. j., extracti taraxaci gr. ij.; to be taken night and morning. Nitrate of pilocarpine has been highly praised by Witkowski, and is certainly sometimes of great service in relieving the pruritus often present. One-sixth of a grain should be given subcutaneously once or twice a day. For the pruritus which is often such a distressing symptom, warm baths at night, followed by the use of a flesh-brush, are sometimes serviceable. Bicarbonate of sodium, with bromide of potassium or belladonna, sometimes affords relief, or, as already mentioned, pilocarpine hypodermically. The following lotion also relieves the itching: Diluted hydrocyanic acid ʒj., borax ʒj., water to ℥viij. When these measures fail, and the night's rest is broken, an opiate may be required. Ox-gall is sometimes useful in supplying the place of the deficient bile. The fel bovinum purificatum (recently prepared) may be given in five- or ten-grain doses in coated pills, three times a day, two hours after meals. Daily enemata of one to two quarts of water at 60° to 90° F., to be retained as long as possible, are extolled by German physicians, especially in catarrhal jaundice. It cannot be too strongly impressed that, whilst using these measures, the physician's aim should be to establish the exact nature of the jaundice, when the correct treatment will be more clearly indicated.

CHARLES MURCHISON. STEPHEN MACKENZIE.

JEJUNUM, Diseases of.—*See* INTESTINES, Diseases of.

JIGGER.—A popular term employed to designate the sand-worm or sand-flea. *See* CHIGOE.

JOINTS, Diseases of.—Diseases of the joints are classified according to the structure primarily or chiefly involved. They may commence in the synovial membrane, in the bone, or in the cartilage. Primary disease of the ligaments is rare, and is not clinically demonstrable. No form of joint-disease remains long confined to one tissue, so that when the disease is of some duration it will be found to implicate, more or less, every element of the joint-apparatus. In this article the diseases of joints will first be generally discussed; and the individual diseases will then be considered separately.

ÆTIOLOGY AND PATHOLOGY.—The larger articulations, those in constant use, and more especially the joints of the lower extremity, are the most frequently diseased. Thus the knee is more often the seat of disease than any other joint; the hip-joint comes next in order; and then the ankle and elbow. All kinds of joint-diseases are frequent in children and young persons. The first year of life appears, however, to be nearly exempt from these affections, and during the second year they are comparatively rare, perhaps because movement and risk of injury are at that period at a minimum. Acute arthritis, however, is occasionally witnessed during the first year of life—during even the first six months. It is unconnected with syphilis or injury; very sudden in its appearance, and rapid in course; dangerous to life; and destructive to the articular ends of the bones by suppurative disorganisation. The causes of joint-disease in general are connected either with disordered nutrition, in which case it usually assumes an inflammatory type; or with disordered function. The latter may depend on the former, or be unconnected with it. Again, the cause may be local in its origin or arise from some constitutional defect. Amongst the *exciting* causes, injury is by far the most frequent. This being often slight, and not followed by any immediate consequences, the connexion is frequently overlooked. A blow, or a fall against the edge of a table or down stairs, may readily bruise the synovial membrane in such exposed joints as the knee or elbow, without causing any external sign. A slight hæmorrhage takes place into the synovial cavity or the sub-synovial areolar tissue, and serous effusion may speedily supervene; in this manner a common variety of acute or traumatic serous synovitis is produced. But although injury is a most fertile cause of joint-disease, the articulations may sustain most severe injury without becoming inflamed. It is rare to find any serious consequences result from dislocation; the joint usually perfectly recovering itself. Penetrating wounds of the joints are always serious injuries; they often occasion acute synovitis, and, if septic changes occur, are followed inevitably by suppuration in the articulation, and danger both to the limb and life of the individual. Fractures often implicate the joint-surfaces, and prove a frequent source of stiff-joint. Plastic synovitis may be thus set up, causing adhesions; or suppuration takes place; or the callus formed for the repair of the fracture may interfere with the joint motion. Gunshot wounds of joints often produce the severest form of inflammation, suppuration being the usual result. When joint-disease follows an injury it is usually confined to one joint; but when joint-disease originates from constitutional causes, more than one joint is often affected; or when only one, the constitutional nature of the cause is manifested in diseased conditions present elsewhere, or by traces of inflammation in other joints due to the same cause. The development of tubercle in the synovial membrane and bone is a very frequent cause of chronic joint-disease.

Joint-inflammations are of common occurrence in all kinds of fever; and also as sequelæ of the exanthemata. The great frequency of polyarticular serous synovitis in acute rheumatism is well known, as also in purpura and hæmophilia, where it is complicated with blood extravasations. In pyæmia the joints are frequently the seat of sero-purulent and purulent effusions; as they also occasionally are in scarlatina. Puerperal synovitis is a variety of the pyæmic. In typhus monarticular arthritis is frequently met with, and the hip is the joint oftenest affected. Endocarditis and polyarthritis are very often associated together, and the endocarditis may precede and give rise to the joint-disorder by embolism. The fact that multiple joint-affections are met with both in pyæmia and in rheumatism suggests a connexion, but what its nature may be is not clear. Although in articular rheumatism pus-formation is rare, we sometimes witness joint-suppuration in such cases; whilst pyæmia and metastatic abscess may originate from ulcerative endocarditis. In chronic synovitis, affecting two or more joints, the heart should always be examined, for traces of endocarditis will sometimes be found. In the exanthemata, typhus, and diphtheria, metastases in the shape of joint-inflammations more or less frequently take place. Joint-inflammation is of frequent occurrence in dysentery. With gonorrhœa a form of arthritis is associated which is called 'gonorrhœal.' Syphilis in the later stages frequently attacks a joint, the knee by preference, syphilitic deposits taking place in the bone or the sub-synovial connective tissue, but synovial effusion is not common. A suppurative inflammation of the ends of the bone is not rare in children the subjects of inherited syphilis. In gout the joint-structures are affected; as a rule the peri-synovial tissue becomes inflamed owing to deposits of urates. Similar deposits also occur in cartilages of encrustation. The great toe is most often affected, but the other tarsal, digital, and larger joints are frequently diseased.

Some ill-understood form of vaso-motor or trophic irritation appears to occasion arthritis, in locomotor ataxy. Effusion into the joint is preceded by pain; and the knee and shoulder joints are those generally affected. In some cases of the disease changes similar to those in rheumatoid arthritis have been observed, and generally in the knee, shoulder, elbow, or hip. They occur early in the disease; arise suddenly; are often monarticular; and not rarely give rise to dislocation, especially in the shoulder. These characters distinguish the disease from ordinary rheumatoid arthritis. Severe inflammation of the joints of the paralysed limbs has been observed in cases of hemiplegia. The occurrence of joint-disorder, usually synovial inflammation, is frequent in chronic disease of the spine; and it also occasionally happens in acute myelitis in the form of suppurative arthritis. In both cases the knee is most frequently affected.

Anatomical Characters. — Joint-disease may begin as an inflammation of the synovial membrane, of the bone, or of the cartilage. Fibrous tissue having but slight tendency to inflame, it is improbable that primary disease affecting the ligaments can be otherwise than most exceptional; but these textures very soon become secondarily affected, from their intimate connexion with the synovial membrane. The synovial membrane is perhaps more ready to inflame than any other tissue in the body, and in many joints it is much exposed to injury from without, while excessive joint-movement alone is sometimes sufficient to excite synovitis. Primary disease of the bone comes next in order of frequency. Cartilage is least likely to take on primary disease. Each of these tissues, however, becomes speedily affected by disease which has invaded or commenced in the other.

Symptoms and Diagnosis.—The local symptoms of joint-disease have reference to *impairment of function* and *change in form*; together with *pain*, both local and sympathetic; and certain *physical signs*.

Impaired function.—Usually this is great in proportion to the natural mobility and importance of the joint, and most evident in the extremities. The earliest symptom in hip-joint-disease is a slight limp or halt, whilst in other joints mere stiffness occurs; the full range of movement is simply curtailed, before actual pain or swelling takes place. The position of maximum relaxation—namely, that intermediate between flexion and extension—is commonly assumed by diseased joints. Even in the early stages of disease, the interference with movement is often very great, amounting to a sort of vital ankylosis, produced by the action of the muscles, whose tension prevents the joint-surfaces moving upon each other—an effort to avert pain. This form of ankylosis disappears during narcosis. Muscular or vital ankylosis must be distinguished from the rigidity produced by structural changes. Both synovial effusion and peri-synovial infiltration mechanically hinder free joint-movement.

Changes in form.—Changes in form are due to the alterations in shape and texture of the joint-structures, and to effusions within its cavity. These changes may be best appreciated by careful measurements, and a comparison with the opposite joint. No true estimate of the amount of departure from the normal is otherwise possible. The practitioner is thus better able to diagnose the special character of the swelling, whether it be due to synovial effusion, and confined to the limits of the capsule, causing it to bulge at the least protected parts; or to chronic thickening of the synovial membrane, recognised on palpation by its elasticity and more general diffusion; or to disease of the bone and periosteum, when the swelling is deep-seated and hard. By accurate comparison a fluid collection outside the joint, either an abscess or a bursal tumour, may be distinguished from intra-articular swelling.

Pain.—The character of the pain is an important symptom in diseases of the joints. In acute synovitis it is severe and lancinating. In bone-inflammation it is a dull aching pain, with marked local tenderness, liable to periodic exacerbations of an intense kind. Often the pain is of a shooting, starting character, wakening the sufferer from sleep. The pain is of this character and most severe in sub-articular ostitis. Pyæmic suppuration and chronic synovitis are generally painless.

Physical signs.—When one hand is laid flat upon a diseased joint while the other moves it, certain sensations or sounds are often distinguishable. A peculiar soft crepitation, due to the presence of blood-clot, must not be mistaken for the rougher sensations which adhesions afford, the friction-sounds of movable joint-bodies, or the grating of exposed bone. The rubbing of one granulation-surface upon another may be likened to that of two pieces of velvet. Abnormal movements, such as lateral motion in a ginglymoid joint, usually imply extensive joint-disorder. Displacement or partial dislocation, and alteration in form of the joint-surfaces, occur as the disease progresses. A notable increase of local heat may be felt in all inflamed joints. When fistulous tracks exist around a diseased joint, they do not often, on being probed, afford direct evidence of the condition of the joint, but they generally prove the existence of articular suppuration, and disease of the bone.

With respect to the *general* symptoms of diseases of the joints, it need only be said here that the amount of pain or constitutional disturbance in acute cases varies according to the extent and acuteness of the disease, and the presence and amount of suppuration. In chronic disorders the associated constitutional condition should be investigated.

COMPLICATIONS AND SEQUELÆ.—The complications which occur in joint-disease are generally connected with long-continued suppuration. Amyloid degeneration of the viscera is pretty certain to be present when suppuration has existed for a year or more in young people; less certainly in adults. Hectic fever, tuberculosis, or pyæmia may occur at any period. In the absence or failure of treatment, the patient, should he survive, will suffer from contraction, deformity, and imperfect growth of the limb, together with more or less complete loss of function.

PROGNOSIS.—The prognosis in diseases of the joints will depend on many circumstances, and must be considered both as regards life and as regards function. First, with respect to *life*, the gravity of joint-diseases increases with the size of the joint affected. They are more serious in the lower than in the upper limb. Pyæmia is comparatively rare in acute joint-suppurations—why, it is impossible to say. When pus escapes from the interior of a joint into the surrounding tissues, pyæmia may occur. A continuous high temperature, or a large evening increase associated with hectic, are bad signs; the exhaustion, which depends on profuse suppuration with its attendant hectic fever, amyloid degeneration, and tuberculosis, are the most frequent causes of death in joint-disease. The prognosis as regards *function* is often difficult to determine. After an attack of simple acute or subacute serous synovitis, recovery is generally complete. Joint-function is usually absolutely lost after suppuration of traumatic origin, recovery being quite exceptional. When the suppuration is of a pyæmic nature and the patient survives, the effusion may become absorbed, and the joint-motion be preserved or ankylosis ensue. Chronic synovitis with thickening of the sub-synovial tissue, due to infiltration with granulation-material, can seldom be cured except by operation, especially after suppuration has taken place. If recovery should take place, the joint-function is lost, and deformity is always present. Increased mobility—'flail joint'—is a very rare sequence of joint-disease. It is occasionally seen in the shoulder, and also in the knee.

TREATMENT.—The treatment of diseases of the joints must be directed to preserve the life of the individual; and, as far as possible, the functions of the limb. Of the first and greatest importance among remedial measures is *rest*, which is best secured by fixation of the joint and limb in an appropriate apparatus. This is of cardinal importance to a diseased articulation, just as motion is a necessity for a healthy one. Immobilisation should not be continued longer than necessary; it will sometimes seriously damage even a previously healthy joint, immobilised for instance on account of fracture of the limb; and a continuance of rest after all diseased action has subsided often exerts a prejudicial influence. Rest, however, should be continued so long as swelling, pain, and increased temperature persist.

Position.—The means adopted to secure immobility must be also utilised to obtain the best available position for the future function of the part, should ankylosis become inevitable. In the ankle the foot should be maintained at a right angle; the hip and knee must be kept extended in the axis of the body; the elbow is generally flexed to a right angle, the position in which the limb is most useful. Splints of various forms are used, and we possess in plaster-of-Paris and starch ready and invaluable means of producing an apparatus which gives uniform and equable support of a simple and very perfect kind.

Extension exerts a beneficial influence, as well by immobilising the joint, as by its power to remove contraction and deformity. It relieves pain and abates the symptoms rather by keeping the joint at rest, and changing the surfaces of contact, than by any actual distraction of the joint-surfaces. A much greater weight than a patient could tolerate would have to be used before any such separation could occur. Extension often even increases the intra-articular pressure. By straightening the limb it removes the joint from its position of maximum relaxation, and puts the skin and tendons on the flexor aspect on the stretch, and alters the mutual accommodation of the joint-surfaces.

As there is almost invariably an increase of temperature in the affected joint, the application of *cold*, by means of ice-bags or coils of cold-water tubing, is indicated. Cold acts most beneficially in all acute, and many subacute, inflammations. Even in deep-seated joints like the hip, it will often soothe the pain and abate the symptoms, but it is more applicable to the superficial joints. Cold is both anæsthetic and prophylactic in its action. The sensations of the patient in respect of the continuance of cold applications must be consulted. In most cases they are grateful. In chronic joint-affections when an acute attack supervenes, threatening suppuration, cold should also be applied. Cold applications may in some cases be continued for weeks or months with advantage. When the acute symptoms have passed off, and it is desirable to encourage lymphatic activity and absorption, the cold must be discontinued, and compression, together with friction and warmth, substituted. Cold is not applicable to purely chronic cases without much pain or tenderness.

In some instances of acute and subacute arthritis *local depletion* by means of leeches or scarification is very useful, and this may be combined with hot *fomentations* in cases where cold is not well borne. In chronic inflammation of the bone the *actual cautery* sometimes procures immediate abatement of the pain, and, after a time, the subsidence of the inflammation. The button cautery may be used, or, still better, linear cauterisation, over the most sensitive points. Or an *issue* may be employed instead.

Compression by strapping, or with a thick layer of cotton-wool and a tightly applied bandage over it, is applicable to the chronic stages of joint-disease. It must be discontinued if it occasion pain. It is better calculated to remove fluid effusions than the plastic material poured out into the peri-synovial tissue. For these cases the more continuous compression of a properly applied elastic bandage will prove more efficient; or the strapping known as 'Scott's dressing.'

Massage is a most valuable local means for the dispersion of chronic swellings of joints. It both removes the results of diseased action in the joint, and helps to restore its function. It is well suited to disperse serous effusions when the acute stage is over; for cases of plastic synovitis it is also useful, but not for cases of the type known as *tumor albus*. It produces a diminution of the sensibility of the part, and a local increase of temperature, and the lymphatics are stimulated to increased activity. There are several modes of employing massage. The first is centripetal stroking with the palm of the hand from the periphery of the affected part towards the centre of the body, called *effleurage*, one hand following the other in immediate succession. The amount of pressure varies with the circumstances of the case. This will readily disperse fluid effusions both of blood and serum. Friction-massage is another useful method, and is practised by pressing the palm firmly upon the surface, and then rotating it. This plan may be combined alternately with the last method, massage proper—*pétrissage*—which is done by raising up the soft parts vertically from the bone with both hands, and compressing them, always in a centripetal direction.

Forcible movements.—Forcible movements, which break down adhesions, are often most useful in cases of stiff joint arising after protracted immobilisation, as after fracture in the vicinity of a joint, or after a severe sprain. Pain will be relieved in this way, and mobility restored in some instances, in a degree quite remarkable. They are less applicable in cases of fibrous ankylosis.

Constitutional treatment.—Where any general taint exists, this must be dealt with at the same time. A tendency to tubercle must be met by iron, tonics, good food, and fresh pure air. Gout, syphilis, or rheumatism must, when present as a diathesis, be appropriately treated.

Operative treatment.—Puncture alone, or combined with antiseptic washing-out of the articulation, may often be performed with advantage, to evacuate the fluid in a distended joint, or to diagnose the presence of pus and evacuate it when suppuration has taken place. Sufficiently free incisions, however, and the insertion of drainage-tubes, are generally to be preferred in cases of joint-suppuration; and with these should be combined the washing-out the joint-cavity with a three- or five-per-cent. solution of carbolic acid, or other effective antiseptic. It has been proposed to substitute free incisions and drainage for excision of the joint, in certain chronic forms of disease, such as white-swelling, but excision, or arthrectomy, is probably in most respects preferable. Excision is practised for chronic joint-disease not amenable to other means; it is not a substitute for amputation, but is intended to obviate its necessity. Sub-periosteal resection, where practicable, possesses many advantages, especially in cases of traumatic origin. The attachments of the muscles and tendons, and the cellular interspaces between them, are thus left undisturbed. The chances of peri-synovial suppuration are diminished, and the bleeding is reduced to a minimum. There is more complete bony reproduction of the joint-surfaces, and in young persons a new joint very similar to the normal is in some instances formed, while in all cases there is a probability of better subsequent function and position. The operation thus performed requires time and skill. It is scarcely applicable to the knee or even the hip, and is unsuited for cases of chronic synovial disease, where it is of the last importance to excise all the diseased granulation-material. The after-treatment of excisions is of great importance. Plaster-of-Paris bandages supply one of the most useful means of immobilisation, especially in those cases where ankylosis is sought for, as in the knee; and the splint should be unchanged, if possible, for four or five weeks. In the elbow, shoulder, and wrist, where mobility is the end aimed at, passive movement should be commenced as soon as the condition of the wound admits of it—namely, in about a week or ten days. Galvanism must be used at a later period to restore the wasted muscular apparatus. Arthrectomy aims at the removal of all the diseased tissue, yet stops short of a formal excision in which healthy parts may be removed.

Amputation is only performed as a last resort. It is very rarely needed for joint-diseases in the upper limb, except perhaps the wrist, when the hand is permanently crippled. In the lower limb, amputation must be performed in those cases in which the patient has lost all strength and healing power, from the drain of a long-continued discharge. It is advisable where amyloid degeneration or incipient tuberculosis exists, or in any case, in short, in which the power of the patient is inadequate to furnish the amount of repair required in the expectant form of treatment, or in case of excision, always a more serious operation than mere amputation. Amputation should also be adopted in those cases in which the local disease, especially of the bone, is too extensive to admit of a good functional result after excision. In the very young formal excision is undesirable, since the epiphyses are almost of necessity sacrificed, and the growth of the limb checked. Resection in some joints is practised to avert ankylosis, or to restore the lost function of the joint, as in the shoulder, elbow, and wrist. Various congenital and other deformities of the joints may be removed by osteotomy of the bones concerned.

The chief diseases of joints will now be separately considered in alphabetical order as follows:—(1) Cartilages, Diseases of; (2) Congenital Dislocation; (3) Immobility; (4) Inflammation, Acute, of the Synovial Membrane; (5) Inflammation, Chronic, of the same; (6) Gonorrhœal Inflammation; (7) Gouty Inflammation; (8) Strumous or Tuberculous Inflammation; (9) Loose Cartilages in Joints; (10) Nervous Affections; (11) Rheumatic or Osteo-arthritis, Chronic; (12) Serous Effusions; and (13) Syphilitic Disease. Rheumatism in its several forms will be considered separately.

1. Joints, Cartilages of, Diseases of.—Primary chondritis as a form of joint-disease is neither clinically nor pathologically established. The cartilage has little tendency to active inflammation; it is not sensitive to pain; chronic changes take place in it as the result of impaired nutrition, rather than inflammation. The cartilages of incrustation are the residue, which does not ossify, of the mass of fœtal cartilage forming the bone-ends. We meet in the joints of the aged with depressions and fibrous scars, caused by partial atrophy of the cartilage; these changes do not occasion symptoms during life, beyond sensations of creaking and roughness in the joint when moved. In osteo-arthritis changes in the encrusting cartilages occur at a very early period, and may possibly in some cases form the primary change.

Almost all the changes which occur in the articular cartilages are secondary to synovitis and ostitis, and more or less passive. In serous synovitis the cartilage is softened and swollen, and becomes to a certain extent œdematous. In suppurative synovitis it becomes rough, sodden, and yellow; its cells burst; the intercellular substance fibrillates; and portions may necrose. The cartilage-changes in chronic synovitis consist mainly in the gradual invasion of the cartilage by granulations, spreading from the synovial tissue at the margins and from the subjacent articular lamella of the bone.

Young growing bones, like the periosteum covering them, readily inflame; and as soon as the inflammation invades the articular surface of the bone, the cartilage becomes loosened and may be necrosed, or gradually invaded by the granulation-tissue springing from the bone. The cartilage is softened; its capsules burst; fibrillation of the matrix occurs; and at different places it becomes thinned. Perforations occur in it, leading to the bone, giving it a sieve-like appearance. Where the inflammatory process is more acute, the whole of the encrusting cartilage may become at once detached from the bone beneath, and necrose.

In these cases the pain, especially at night, is very severe. Involuntary starting of the limb causes intense suffering, wakening the patient from sleep with a scream. This symptom was formerly considered distinctive of ulceration of cartilage, a process which is perfectly painless when it occurs without other disease in the joint; but it is probable that the pain is due to pressure upon the inflamed bone, and it may sometimes greatly abate when the cartilage wholly disappears. Disease commencing near the epiphysial cartilage often extends to the adjacent joint. Those joints in which the epiphysial junction is within the capsule, as, for instance, the hip, run a double risk from bone-inflammation.

2. **Joints, Congenital Dislocation of.**—Description.—This is a curious and ill-understood affection of the joints. It is almost exclusively confined to the female sex. The hip-joint is nearly always the one affected, and the displacement is generally double. It has often been erroneously mistaken for morbus coxæ, and treated accordingly.

It probably occurs in early fœtal life from defective formation of the joint-surfaces. It is not discovered until the child begins to walk, which it generally only commences to do at a late period. When the hips are the joints affected, the gait is accompanied by a most ungainly swaying of the body from side to side like the waddling of a duck. All that can be done is to supply a well-contrived artificial support to the pelvis and limbs.

Genu valgum and *genu varum* (knock-knee and bow-knee) are two forms of disabling and unsightly deformity of the lower limbs. They are often due to an abnormal development of the condyles or shaft of the femur, or the tuberosities of the tibia, and to changes of a rickety character at the epiphysial junction. In extreme cases progression is greatly interfered with. The symptoms are painfully obvious.

Treatment.—Treatment of the limb by splints and apparatus and forcible straightening and subsequent maintenance in plaster-of-Paris bandages succeeds in the milder cases, but in those of a severer type, or in persons of ten years or upwards, this plan is most tedious, and is usually attended by complete failure. The subcutaneous division of the internal or external condyle, according to the nature of the deformity, restores the joint-surfaces of the femur to their normal level, and is attended by the happiest results both to the form and function of the limb and joint. It is an easier and in many ways a more successful operation to divide the shaft of the bone with a chisel near its articular extremity, and thus procure the rectification of the limb.

3. **Joints, Immobility of.**—Synon.: Ankylosis; Fr. *Ankylose*; Ger. *Gelenkverwachsung*.

Ætiology.—This condition may be due to changes in the structures of the articulation constituting a *true ankylosis*; or in those surrounding the joint, a *false ankylosis*. It may be fibrous and incomplete, or bony and complete. False or spurious ankylosis—extra-articular—may depend on muscular spasm or rigidity; on cicatricial contractions; on paralytic or spasmodic affections; or upon prolonged disuse of the joint. It is often difficult, even under chloroform, to distinguish the presence of absolute bony ankylosis, as the fibrous form may be so strong and extensive as almost wholly to prevent movement. The two varieties are but degrees of the same process. Both may result from previous inflammatory changes in the joint, either of the nature of plastic synovitis, or of granulations springing from the bone and other joint-tissues, becoming further organised. Fibro-cartilaginous ankylosis is a common form in young persons. In time it usually becomes converted into true bony ankylosis.

The marked ankylosis which tonic spasm and rigidity of the muscles produce in the early stages of some joint-diseases, as in the hip-joint and knee, may be called *vital* or *physiological*. It is induced by an effort to avert pain; it disappears entirely during narcosis. A joint may become stiff and ankylosed by long fixation on account of some injury or disease elsewhere, especially if it be retained in a flexed position, as the muscles of the flexor side actually shorten when their points of origin and insertion permanently approach one another. The same thing may also happen in the myogenic affections due to paralysis; in which the cartilages and bones atrophy at the same time.

Treatment.—The treatment of diseases of joints should, in all cases where it is possible, be prophylactic against the occurrence of ankylosis. When this has taken place in an incomplete degree, an attempt to restore the function of the limb must be made, by breaking down the adhesions by forcible or gradual extension, by passive motion, by massage, and by tenotomy of the tense tendons. Excision is indicated to restore motion in complete ankylosis of such joints as the wrist, the elbow, and the shoulder. In other cases of complete ankylosis, especially in the lower limb, surgical interference should be confined to an attempt to rectify a faulty position either by tenotomy, extension, forcible straightening, excision, or osteotomy. Amputation can only be needed in extreme and otherwise irremediable deformity.

4. **Joints, Acute Inflammation of the Synovial Membrane of.**—Synon.: Acute Synovitis; Fr. *Synovite Aiguë*; Ger. *Acute Synovitis*.

This is one of the most common of all joint-affections. Probably in half the total number of chronic joint-diseases the synovial membrane is first affected. The synovial membrane is very rich in vessels and cells; and much exposed to injury, and to the effects of movement. An inflammation beginning at one point soon spreads over the whole synovial sac.

Description.—Acute synovitis is a very common result of injury. It also occurs in rheumatism, gout, pyæmia, and other diseases. It may be serous, sero-fibrinous, or purulent. Serous synovitis is the simplest and most common variety. Even a slight external injury is often sufficient to produce it; a sprain of the joint, or excessive movement, may cause it, as well as the constitutional disorders already mentioned. The knee is very often affected, from its exposed position, and the large area of the serous membrane lining it. The synovial membrane becomes injected and thickened, with effusion into the sub-synovial tissue. The natural secretion is increased in quantity, and many cells are shed into the joint cavity, the capsule becoming swollen, tense, fluctuating, or elastic. The least protected parts bulge, from the pressure of the effused fluid, and the normal contour of the joint is lost. It is usually semiflexed. A severe burning, cutting pain is experienced in it. It is exceedingly sensitive to pressure, and painful on the slightest movement. There is usually considerable fever. When the inflammation is more intense, the synovitis becomes sero-fibrinous. Flakes of lymph are mingled with the synovia; layers of false membrane cover the synovial membrane, which is considerably thickened and dull red in colour; and the constitutional disturbance is greater. Finally, it is but a short step from this to suppurative synovitis. If the irritant cause continue its action, the leucocytes filling the meshes of the synovial membrane are shed in larger quantity; the fluid becomes turbid and puriform; the fever and local symptoms increase very much in severity; the external parts become implicated in the inflammation within; and suppuration or abscess is the result.

Treatment.—The treatment of the first two stages of synovitis is directed primarily to check the progress of the inflammation; and then to procure resolution, and absorption of the effused fluid. Fortunately the synovial membrane possesses very active absorbent powers; and early and efficient treatment, conjoined with removal of the source of irritation, will generally ensure a cure, with complete restoration of function. The chief means are cold applications; immobilisation till the acute stage is over; and then compression and friction, or in suitable cases counter-irritation. Gout, rheumatism, or other diathesis, must be appropriately treated at the same time.

In those cases in which the inflammation has persisted for some time, and plastic effusion has taken place on the surface and in the substance of the synovial tissue, the joint will remain for a long time stiff and thickened, and its function impaired, after all acute symptoms have subsided; whilst in those cases where the inflammation has continued long enough to invade the other joint-structures, a perfect cure may not be possible.

When suppuration occurs, the joint must be dealt with as any other abscess-cavity. Free incisions must be made into it, and it should be thoroughly washed out with some antiseptic solution, free subsequent drainage being provided for. In the more favourable cases, ankylosis in a convenient position will be obtained. Recovery of function is very rare. In other cases the suppuration continues; the cartilages of encrustation become necrosed and detached; the bone becomes exposed and carious; and either excision or amputation must be performed to save the patient's limb or life.

5. **Joints, Chronic Inflammation of the Synovial Membrane of.**—Synon.: Chronic Synovitis.

Chronic synovitis may arise as the sequel of the acute disease; or, as is more frequent, it may depend on some constitutional dyscrasia, or at least some continuously acting irritant, although in the first instance it is generally excited by an accidental injury.

Varieties.—There are three chief varieties of this disease which are often co-existent, namely: *pannus synovitis*, *granulation synovitis*, and *papillomatous synovitis*.

a. Pannus Synovitis.—In this variety a delicate membrane will be found, stretching from the inflamed and thickened synovial margins more or less over the surface of the cartilage, to which it may be in whole or in part adherent.

b. Granulation Synovitis.—The second, or granulation form, is a more advanced stage of the disease. In it the synovial membrane is often completely replaced by granulation-material, which encroaches on the margins of the cartilages, and, as the disease progresses, invades them, and coalesces after a time with granulations springing from the inflamed bone. These granulations are pink or greyish-red, not so vascular as those in an ordinary wound. They have little tendency to cicatricial change, and are prone to break down and form abscesses.

The synovial membrane often becomes enormously thickened from the granulation-material accumulated in it, and this form of disease is frequently associated with the tubercular diathesis. Bodies identical with miliary tubercles are very often found in the semi-gelatinous or pulpy synovial membrane; the whole constituting what is known as *tumor albus*, or 'white-swelling.'

Symptoms.—The more prominent symptom

associated with the form of chronic synovitis just described is the presence of a uniform semi-elastic swelling, caused by the sero-fibrinous infiltration into the synovial membrane. The skin is whitish, tense, and smooth, whence the name *tumor albus*. The amount of synovial effusion into the joint is usually limited; the pain is seldom severe; the amount of joint-movement is diminished; and there is usually contraction of the limb, and sometimes partial dislocation. When suppuration occurs, there is more pain and fever. The course of the disease is generally very chronic, extending over months or even years, and allowing the patient at intervals to take moderate exercise. Exacerbations take place, however, from slight causes, or without apparent cause; attacks of subacute or acute inflammation supervene; and sooner or later abscesses form, communicating both with the cavity of the joint, which becomes totally disorganised, and with the surface.

Brodie's 'pulpy disease of the synovial membrane' is simply an exaggerated degree of granulation synovitis, in which the sub-synovial tissue becomes enormously thickened by successive attacks of inflammation.

Treatment.—The disease is most rebellious to treatment, and scarcely curable amongst the poorer classes without operation. Sometimes the diseased tissue is got rid of by suppuration; and, if the patient's strength suffice, a cure by ankylosis, probably accompanied by considerable deformity, will ensue. Generally, however, the symptoms become worse; the general health gives way from the drain of the continuous discharge; and amyloid or some other intercurrent disease kills the patient. At any time, as in a suppurating wound, pyæmic symptoms or hectic may set in.

c. Papillomatous Synovitis.— Synon.: Fimbriated Disease of the synovial membrane; Papilloma, or Papillary Fibroma of the synovial membrane; Ger. *Gelenkzotten.*

This is a peculiar form of joint-disease dependent on chronic synovitis, in which numerous pedunculated bodies, cylindrical or fusiform, varying in size from a pin's-head to a large pea, project from the membrane, generally near the cartilage margins, or may cover the entire surface. These bodies are identical in minute structure with the synovial fringes. Some become detached, and fall into the cavity of the joint. The disease is essentially a hyperplasia of the synovial adventitia; and there may be dozens or hundreds of these bodies present in one joint. Occasionally they contain cartilage cells, or osseous particles. The joints of the lower limb are most often affected.

Treatment.—The disease is scarcely remediable except by arthrectomy or excision of the joint, which may be practised in those cases in which there is serious loss of function.

6. **Joints, Gonorrhœal Inflammation of.**—This disease is often called 'gonorrhœal rheumatism.' It is almost always observed in the male, very rarely affecting the female. Generally one joint, usually in the lower limb, is involved, as the knee or the ankle. It is pyæmic in nature. It may affect several joints in succession. It may occur at any period of a gonorrhœal or even a gleety discharge, of which the patient himself is possibly unaware. The fibrous tissues of the joint seem to be primarily engaged. Sclerotitis and inflammation of the internal layer of the cornea often co-exist; rarely either endo- or peri-carditis. The joint-effusions contain gonococci.

Symptoms.—The joint affected is exquisitely tender on pressure; it is swollen rather from subcutaneous œdema than by intra-articular effusion, which is frequently inconsiderable; and one side of the joint is often more affected than the other. The fever is not in proportion to the intensity of the local symptoms, the rise of temperature being slight. The course of the disease is slow and obstinate; but when cured it is not liable to return, except with a fresh attack of gonorrhœa. These characters distinguish it from ordinary rheumatism.

Treatment.—Rest, cold applications, and the internal exhibition of iodide of potassium constitute the best treatment for gonorrhœal inflammation of joints. *See* Rheumatism, Gonorrhœal.

7. **Joints, Gouty Inflammation of.**—Gout frequently occasions synovitis, by the deposit of urate of sodium in the peri-synovial tissue, which excites a synovial effusion. The attacks are very acute and painful; and, as they recur, the joint becomes more and more disorganised, from permanent deposits of urates in the cartilages and bone, as well as in the peri-synovial tissue. The use of the joint is lost; and the 'chalkstone,' as it is called, acting as a foreign body, sometimes produces an abscess, or an ulceration very troublesome to heal. When the collection is quite superficial, it may often be evacuated by incision with great relief. *See* Gout.

8. **Joints, Strumous or Tuberculous Inflammation of.**—Scrofulous or strumous inflammation of a joint is a vague term, hitherto taken to denote a form of chronic inflammation in ill-nourished persons—nearly always children—who live under bad hygienic conditions, and are prone to the development of tubercle. It is observed most frequently in the knee- and hip-joints.

Recent investigation has shown that many forms of chronic disease of joints are due to tuberculous infection of the constituent parts of the joint.

A considerable proportion of the cases described under the title *tumor albus* are cases of tubercular disease of the synovial membrane; while in others the articular disease is the consequence of tubercular ostitis of the ends of the joint.

Anatomical Characters.—This disease generally commences in the synovial membrane, which becomes thickened, and by degrees converted into a semi-gelatinous mass of granulation-tissue, yellowish-white or pink in colour. Or the disease may originate in osteomyelitis of the end of the bone, the inflammatory process being essentially chronic and dependent upon the presence in the tissues of miliary tubercle. After the disease has existed for some time, it is difficult to determine in what tissue it may have originated, and it is of little clinical importance to do so, for in any case the later stages of the malady present similar features. The cartilages are encroached upon from their margins and from their deep surfaces by the granulations, springing from the synovial membrane and the articular lamella, whilst active changes occur simultaneously in their substance, similar to those already described. The ligaments soften, and all the structures of the joint become involved. Frequently larger or smaller masses of necrosed bone will be found in the cancellated structure, and the granulations have a great tendency to suppurate. In the thickened synovial membrane, and also in the ends of the bones, miliary bodies, identical with tubercles, may very frequently be detected.

Symptoms.—In tubercular inflammation of the synovial membrane the joint is uniformly swollen, tense, elastic, with a white glistening surface, and enlarged veins shining through the skin. The patient can usually move about until suppuration has taken place, as the pain is never very severe in the intervals of the acute attacks of inflammation which supervene from time to time. Enlargement of the lymphatic glands, or marks of strumous ulceration elsewhere, are seldom wanting; whilst sooner or later a large proportion of the individuals affected by this form of joint-disease show signs of general tuberculosis. Sometimes this state precedes, but generally it follows, the local joint-affection. Inherited syphilis appears to be a predisposing cause of tubercular arthritis. When the disease begins in the bone the localised tenderness and deep-seated thickening, conjoined with the general symptoms, may reveal the nature of the process before the more general invasion of all the joint-elements.

Treatment.—This must be mainly directed to improving the patient's general condition. Any local treatment, short of a complete removal of the diseased structures, is not of the least use when the joint has become disorganised, as before described; and some form of excision should be performed before the viscera become implicated. If other organs be involved, or the local disease be too extensive, then amputation becomes imperative. When not removed, fresh foci of suppuration form; the patient becomes more and more exhausted; or some intercurrent disease sets in. It is rare for spontaneous cure to happen.

9. Joints, Loose Cartilages in.—Synon.: Fr. *Corps Flottants Articulaires*; Ger. *Gelenkmäuse*.

Description.—'Loose cartilages' in joints may originate either from chronic inflammation, or from traumatic causes. They may be single or multiple. The knee-joint is most frequently affected, and in it the most serious symptoms are produced. These bodies may be fibrous, lipomatous, chondromatous, or osteo-chondromatous. They may be produced from polypoid growths springing from the synovial membrane in certain forms of chronic synovitis, and in arthritis deformans; and they are then usually of the fibrous or osteoid variety. Lipomatous free bodies are rare, and are derived from the sub-synovial fatty tissue, being produced in a fashion analogous to the appendicæ of the great intestine.

The chondromatous and osteo-chondromatous are the largest and most important varieties of these bodies; hence the common term 'loose cartilage.' Portions of the joint-surface may sometimes become detached, as the consequence of injury, or by a process of quiet necrosis. They thus become loose in the joint. It is stated, but the fact is doubtful, that some of these bodies may obtain nourishment from the surrounding synovial fluid, and that cartilage and even bone can be developed in them subsequently to their detachment.

Symptoms and Diagnosis.—The symptoms of loose cartilages in a joint vary very much. In some instances these bodies cause no inconvenience. In others they produce repeated attacks of excruciating pain, followed by synovitis, laying the patient up for weeks; whilst in the most severe cases the limb may become almost useless. When the knee is the joint affected, the patient experiences great insecurity in walking, the loose body from time to time becoming wedged between the joint-surfaces. The joint is thus 'locked.' The patient may suddenly fall, or faint with pain; an attack of synovitis follows; and with a frequent repetition of this process joint-disorganisation may finally result. The prognosis as regards function is always bad.

Treatment.—The treatment of loose cartilages may be either *palliative* or *radical*.

The *palliative* method consists in applying support to the joint; limiting its movements; and fixing the loose body in some synovial pouch where it cannot interfere with the articular surfaces.

The *radical* method consists in excising the body—an operation, with few exceptions, almost exclusively practised upon the knee-joint. The body may be removed by a free direct incision into the joint, and squeezing the body through the wound at once. Or the indirect manner of operating may be adopted. This consists in subcutaneously incising the capsule of the joint with a long, narrow-bladed knife introduced at some distance from the articulation; forcing the body through this incision into the cellular tissue outside; and then closing the small external puncture in the skin. Three or four weeks later the 'cartilage' may be removed by a superficial incision, or left undisturbed, when it often becomes absorbed.

In appreciating the comparative value of these two plans, it may be said that the former has hitherto proved more uniformly successful *quoad* extracting the body, but that it has been more dangerous to limb and life—a danger, however, which antiseptic precautions reduce to a minimum. The indirect method has been attended by a considerable number of failures in the extraction of the loose cartilage, especially if it be pedunculated; but it has hitherto proved a less dangerous operation. The extremity should be immobilised afterwards for two or three weeks.

When some dozens of these bodies are present in a joint, many of them free, many attached, excision of the articulation is often the only remedy. This is a severe measure, and not to be lightly undertaken, in the joints of the lower limb at all events.

10. Joints, Nervous Affections of.—Synon.: Hysterical Joint; Neuralgia of Joints; Arthralgia; Fr. *Arthralgie Hystérique*; Ger. *Gelenkneurose.*

Description.—*Hysterical affections* present symptoms simulating real joint-disease so closely that the most energetic therapeutic measures have often been resorted to, though in vain, for their cure. Prolonged immobilisation, blistering, the actual cautery, resection, and even amputation, have been practised upon joints in which there was not a trace of organic disease.

The existence of hysterical affections of joints is denied by some; but assuredly they do occur; and most often in young women, well-to-do in life, with disordered catamenia. The same thing occurs, but less frequently, in young men. The disease is not witnessed under the age of puberty. The hip and knee are the joints principally complained of—most frequently the latter. An all-important feature of a hysterical joint is that, while the local symptoms may be intense, the general symptoms are either absent, or in no sort of proportion to the local.

A special character of this disease is that deep pressure is often less painful than superficial pressure; and that the pain and tenderness are vague, shift from one point to another, and will disappear at a given spot when the patient's attention is directed elsewhere. There is pain on movement, but of an indefinite character, and not so limited or localised as in real disease. Nocturnal startings do not occur; the patient may enjoy uninterrupted sleep for hours. There is never a continuous rise of temperature, either general or local; the co-relation of the symptoms is not the usual one; the function of the joint is much more interfered with than the other features of disease present would appear to justify. There is an exaggerated fear of examination; and the *facies hysterica* is often well-marked. There may be thickening around the joint, and even marked synovial effusion into it; but these conditions are passive in character, and generally due to the treatment employed. The limb is wasted and consequently weak, but never to the same extent as in real joint-disease. Exacerbations occur at the menstrual period. A careful inquiry should be made into the history and antecedents of the case. An examination under chloroform will often afford important evidence; and the patient's symptoms will be improved afterwards by the movements then practised on the joint.

Neuralgic pain in the articulations may arise under different circumstances. It may be the referred pain, unattended by local lesion, which is so frequent in the knee in cases of hip-joint disease. Neuralgic pains in various joints are observed in the preliminary or early stages of chronic myelitis. In the first stage of locomotor ataxy the knee may be affected by severe neuralgia when the disease is low down in the cord; or the shoulders when it is at a higher point. Lastly, so-called neuralgia of a joint may really indicate some obscure lesion, as chronic inflammation of the bones entering into the formation of the articulation.

Treatment.—The methodical exercise of an *hysterical* joint is as plainly indicated as rest is imperative in a case of organic disease. The bowels should be regulated, as also the menstrual flow. Asafœtida, iron, and quinine are most important remedies; and healthy mental and moral influences are valuable adjuncts. 'Get up and walk' is a good prescription in many such cases. Very careful and repeated examination should always be made, to exclude any possible form of chronic inflammation, before pronouncing a joint to be hysterical. It must not be forgotten, however, that after slight injuries which produce some inflammatory symptoms, those of hysterical joint may supervene, and persist long after all traces of organic disease have disappeared.

The treatment of *neuralgia* connected with a joint will necessarily vary with its cause. *See* Neuralgia.

11. Joints, Chronic Rheumatic Arthritis of.—Synon.: Osteo-arthritis; Fr. *Arthrite avec Usure des Cartilages*; *Arthrite Sèche*; Ger. *Altersabschleifung.*

Ætiology and Pathology.—The number

of names that have been applied to this disease betrays the obscurity enveloping its pathology. In nature it is, however, essentially a senile degeneration, accompanied by chronic inflammation; and is, in part, perhaps, the result of wear and tear of the joint. It is most common in hard-working people, exposed to the influence of wet and cold, and in the aged. One or many joints may be affected; generally the fingers, the toes, the hip, and the knee. It may be set up by injury, such as a sprain, dislocation, or fracture; or it may arise without known cause. It is difficult to say which of the tissues is primarily at fault, but sooner or later all become involved. The synovial membrane inflames; papillary outgrowths form upon it; the cartilage swells; and the ends of the bones enlarge. After a time the quantity of synovial fluid diminishes; the joint friction increases; the cartilages are rubbed away at the surfaces of contact; and finally the bone itself, which becomes denser by interstitial deposit, disappears. The surface is eburnated, and marked with striæ produced by friction; whilst deposits of new bone, which may often be felt externally, form around the margins of the joints, so that the area of its surfaces becomes greatly increased.

Symptoms.—The symptoms of chronic rheumatic arthritis chiefly consist in constant pain, of a dull aching character, and worse at night. Motion becomes more and more difficult and painful as the disease advances; but ankylosis never occurs. Rough crepitus is felt both by the patient and the surgeon when the joint is moved. *See* Rheumatic Arthritis.

Treatment.—The treatment of osteo-arthritis can only be palliative. It consists in the use of warm douches and other warm applications, and the administration of iodide of potassium internally. The disease is incurable.

Charcot's Disease.—This is a peculiar form of osteo-arthritis, affecting usually the larger joints, such as the knee, hip, and shoulder, and occurring in connexion with tabes. The disease, therefore, is of central origin and dependent on sclerosis of the spinal cord. In some cases, however, evidence of a central lesion is absent.

In many instances the changes in the joint are similar to those in osteo-arthritis, while in others there is much more rapid and extensive destruction of bone. Besides the destructive changes which occur in the joint, there is often abundant proliferation and ossification of the cartilage margins, so that new irregularly formed masses of bone are found, it may be to as great or even a greater extent than in osteo-arthritis.

Symptoms.—The malady occurs as a rule somewhat early in the progress of a case of tabes. The onset is rapid, the synovial effusion greater than in osteo-arthritis, and the wasting and wearing away of the cartilage and bones much quicker.

The swelling generally occurs in the affected articulation quite suddenly and without pain; there is no pyrexia or local evidence of inflammation. Most commonly the knee is affected. The general symptoms of incoordination may be strongly marked or altogether absent. It is well to carefully look for them in all cases of extensive chronic enlargement of a joint in the adult. *See* Tabes Dorsalis.

Treatment.—The treatment consists in giving the affected joint rest, and in the employment of suitable remedies to control the progress of the central nervous trouble. The prognosis in most cases is very unhopeful.

12. Joints, Serous Effusion into.—Synon.: *Hydrops Articuli*; *Hydarthrosis*; Fr. *Hydarthrose*; Ger. *Gelenkwassersucht.*

This is a form of chronic serous synovitis, in which there are no obvious inflammatory symptoms. The joint sometimes becomes greatly distended; the ligaments are stretched; and in consequence there is a sensation of tension and feebleness in the articulation. The knee and elbow are most frequently attacked; and the disease is often associated with a gouty or rheumatic diathesis, or with rheumatoid arthritis. It is very difficult to cure. The joint may be punctured and the fluid drawn off; or, still better, it may be injected and thoroughly washed out with iodine (equal parts of the tincture and water), or with a carbolic acid (2½ to 5 per cent.) solution. Relapses, however, are common.

13. Joints, Syphilitic Disease of.—This disease may originate in children, in the form of a suppurative ostitis at the junction of the epiphysis and diaphysis. Other signs of congenital syphilis will help to establish the diagnosis. The disease runs a rapid course, and the joint is frequently destroyed. In the adult a chronic plastic synovitis, due to gummatous infiltration of the peri-synovial tissue, or of the bone and periosteum, is the more common form. There is very little fluid effusion within the joint, but considerable impairment of mobility is produced by the thickening outside it. The progress of the disease is slow and painless, except at night or on motion. The history of the case; the presence of traces of syphilis elsewhere; and the effects of treatment, will help in establishing the diagnosis. The internal use of mercury and iodide of potassium, combined with local pressure by means of strapping with mercurial plaster, speedily effects a marked improvement and cure.

William Mac Cormac.

JUGULAR VEINS, Physical Signs in connexion with.—The principal physical signs in connexion with the jugular veins are distension, pulsation, and venous hum. *See* Physical Examination.

K

KELOID. — Synon.: Fr. *Chéloïde*; *Kéloïde*; Ger. *Keloid.*—*Keloid* and *cheloid* are two words resembling each other in sound, and sometimes used indiscriminately, but differing altogether in origin and signification. *Keloid* is derived from κηλίς, a mark or blemish; whilst *cheloid* derives its origin from χηλή, a crab's claw. The disease which we now recognise as cheloid was first described by Alibert under the name of *kelis*, with the synonyms *cheloide* and *cancroide*, and is therefore sometimes referred to as the 'kelis of Alibert' (*see* Cheloid). The term 'keloid' has, however, been applied by Addison to a blemish of the skin, resulting from a fibrous degeneration of the derma allied with scleroderma; hence the use of the term *Addison's keloid*. Both diseases are really fibromata; but one, namely cheloid, is a tumour, while the other, kelis, is flat, and often resembles a cicatrix. There is another obvious difference between them: cheloid is restricted to the derma, whilst kelis follows the subcutaneous connective tissue to the deeper textures of the body. The early dermatologists described kelis under the name of *morphœa*, and by that name it is still distinguished by some modern writers.

Erasmus Wilson.

KERATITIS or KERATODEITIS (κέρας, a horn, the cornea).—Inflammation of the cornea. *See* Eye, and its Appendages, Diseases of.

KERION (κηρίον, a honeycomb). — A term applied to a pustular folliculitis of the scalp. The inflamed skin occurs in the form of one or several blotches of a deep red colour, prominent, and dotted over with yellow spots—the apertures of the follicles, from which the hair has been expelled, and which exude a copious muco-purulent fluid. The yellow spots are converted into hollows by the tumefaction of the framework of inflamed skin, and no doubt thereby suggested the idea of a honeycomb, whilst the muco-purulent secretion might in like manner be compared to honey. Another feature of the disease is the elimination of the hair from the inflamed follicles, and the subsequent baldness of the affected part. Kerion is sometimes associated with tinea capitis. *See* Tinea tonsurans.

Erasmus Wilson.

KIDNEYS, Diseases of. — Synon.: Fr. *Maladies des Reins*; Ger. *Nierenkrankheiten.*—The kidney is subject to a number of diseases, which will be considered in the following pages in alphabetical order. At the outset, however, it will be convenient to present an outline of the abnormal phenomena to which these affections may give rise.

Summary of Symptoms.—The facts upon which the diagnosis is founded in diseases of the kidneys are of three classes, namely: A. **Abnormal local conditions.** B. **Abnormalities of the urinary secretion.** C. **Abnormalities in other parts of the system, secondary to the local phenomena.**

A. **Abnormal local conditions.** — These may be:—

a. Subjective.—The patient may experience pain or uneasiness in the region of the kidney on one or both sides; and abnormal sensations may be also referred to the ureter, the bladder, or the urethra. The pain may be influenced by attitude or by exertion; and be either constant, paroxysmal, or periodic. It may be aggravated, relieved, or unaffected by pressure.

b. Objective.—Examination of the abdomen and pelvis, by means of palpation and percussion, may reveal the presence of a tumour connected with the kidney. The tumour may be solid or fluid; uniform or lobulated. Tumours of the kidney may generally be made out by palpation, and especially by tilting with the one hand the mass forwards from the lumbar region, upon the fingers of the other hand applied in front. In some cases the absence of the kidney from its normal position may be ascertained by percussion in the lumbar region. By careful observation of the relative form of the two sides at the back and in front, either the presence of tumour, or the absence of the organ, may be rendered distinct.

B. **Abnormalities of the urinary secretion.**—*a.* The urine may be altered in *quantity.* It may be increased, as in waxy degeneration of the kidney, or in advanced stages of cirrhotic and inflammatory Bright's disease; or diminished, either from obstruction to its escape, or from failure of secretion. The conditions leading to obstruction to outflow are certain diseases of the urethra, prostate, bladder, or ureters; the last named inducing suppression only where both the ducts are simultaneously occluded, or where, one kidney having been previously destroyed, the ureter of the other side subsequently becomes affected. The impaction of calculi, and the pressure of new-formations, are the chief causes of these obstructions. The conditions leading to diminution or failure of secretion are the pyrexial state; obstruction of uriniferous tubules, as by inflammatory products; long-standing passive congestion, as in cardiac disease; and, probably, some forms of altered innervation.

b. The urine may be altered in *colour*, as from the presence of blood, pus, bile, purpurin; or of substances introduced into the system, such as logwood, rhubarb, senna, tar, and carbolic acid.

c. The *specific gravity* may be altered, being much raised when the proportion of water is small, or when an excessive amount of sugar or of urea is being eliminated, or when a large proportion of blood or of albumin is present. Diminution occurs whenever the proportion of water is excessive, or the elimination of urea deficient. It is thus an important feature of renal disease. In determining the specific gravity it is important to remember that, when the specimen has stood for some time, it may vary in different parts of the same column of fluid; that it varies with the temperature, being lower in warm than in cold fluid; and, further, that it varies at different times of the day, in relation to the state of the digestion.

d. The *reaction* of urine varies from the slightly acid standard of health, by being either too acid or alkaline. The acidity may be excessive when the urine is passed, or may become increased after it has been voided, in consequence of the acid fermentation. It may be alkaline when passed, from the presence either of fixed alkali or of ammonia. The ammonia results from decomposition of urea, and this change constantly occurs in urine which has been kept and allowed to decompose.

e. Albumin is a common morbid constituent of urine, either temporary or permanent. Several albuminous bodies are met with, but the most important are serum albumin, serum globulin, and peptone. Temporary albuminuria may be artificially produced by the ingestion into the stomach, or by subcutaneous injection, of raw albumen of egg; and it sometimes results from derangement of the digestion, due to the use of indigestible articles of food or from muscular exertion. It occurs in certain blood-diseases, such as scarlet fever, erysipelas, diphtheria, and acute yellow atrophy of the liver, and is probably due to the irritation of the kidneys by the poisons proper to these maladies. It also occurs in some cases where fever is high and persistent, and is then to be explained by alteration of the condition either of the vascular walls, of the renal cells, or of the innervation of the kidneys. It also occasionally results from the use of certain drugs, such as turpentine and cantharides; certainly sometimes from nervous affections, such as exophthalmic goître, epilepsy, and injuries to, or organic disease of, the brain. Permanent albuminuria is met with in all the forms of Bright's disease: most abundantly in the inflammatory form; to a less extent, but constantly, in the waxy; to a still less extent (and sometimes altogether absent) in the cirrhotic variety. It also results from passive congestion of the kidneys, due to cardiac disease or other cause; as well as from suppurative nephritis and other diseases of the kidney, and from pyelitis. The ordinary albumin of the blood-serum is the form which usually appears in the urine. Now and then it is found, especially in the course of or after acute febrile diseases, that a variety of albumin occurs in the urine which is unaffected by heat and nitric acid, but which becomes coagulated by alcohol. This may either be from alteration of the substance itself, or from the presence of some material which interferes with the ordinary chemical reaction. The indications to be derived from the presence of peptones in the urine are not yet definitely ascertained. *See* ALBUMINURIA; ALBUMOSES; and ALBUMOSURIA.

f. Urea is diminished in quantity wherever there is destruction of the renal epithelium, as in the different forms of Bright's disease, especially the cirrhotic and inflammatory varieties.

g. The *physical* and *chemical* characters of the urine are often much modified by conditions other than diseases of the kidneys themselves, and abnormal ingredients may be present, such as sugar or bile, but these alterations do not come within the scope of the present article. *See* URINE, Morbid Conditions of.

h. Deposits are also frequently present in the urine, which are due to various causes apart from renal disease, namely, urates and uric acid, oxalate of lime, phosphates, cystin, xanthin, tyrosin, and leucin. Organic deposits are important in many affections of the kidney or its pelvis. In the first place the *epithelium* from the latter may be present in more or less abundance. *Pus* appears as a fine granular yellowish deposit, which becomes viscid and transparent on the addition of liquor potassæ. In ammoniacal urine it is sometimes found that the pus-cells have undergone this change within the bladder. Pus may be derived from the pelvis of the kidney, or from the kidney-substance itself. Deposits very similar in general appearance to pus are sometimes seen in cases of scrofulous kidney, but the microscopic appearances are different, the corpuscles being altered, and often associated with fibrous tissue. *Cancerous* deposits, showing distinct cancer-cells, are also sometimes met with. The presence of *blood* or of its *pigments* gives the urine a smoky, pinkish, or actually bloody appearance. *See* HÆMATURIA; MICROSCOPE IN MEDICINE; and LEUCIN.

Tube-casts are sometimes so numerous as to constitute a deposit quite visible to the naked eye. These casts are solid moulds of the uriniferous tubules, sometimes formed within the free lumen of the tube, but far more frequently within the basement-membrane, thus including the more or less altered epithelium. The simplest form of tube-cast is the hyaline, a clear structureless cast. Blood-casts are common, containing distinct red corpuscles. Epithelial and desquamative casts are opaque and granular, the granular condition being due for the most part to the abundance of altered epithelium in their substance. Fatty casts are those which exhibit evidences of fatty degeneration of the epithelium. *See* BRIGHT'S DISEASE; CASTS; and URINE, Morbid Conditions of.

C. **Symptoms occurring in other parts of the body.**—Very important symptoms occur in connexion with renal diseases, affecting the organs of circulation and of digestion, the nervous system, and the skin; but these are for the most part associated with Bright's disease. *See* BRIGHT'S DISEASE; and URÆMIA.

SPECIAL DISEASES.—The several diseases of the kidney will now be indicated, and those will be discussed which are not described under special headings in other parts of the work; for example, Bright's Disease and Renal Calculus.

1. **Kidney, Abscess of.**—This is often used as a generic term to include any accumulation of pus in connexion with the kidney, whether in the substance of the organ, in its pelvis, or even around it. Strictly, it applies only to a collection of matter resulting from suppuration in the kidney-structure itself. *See* 12. Kidney, Embolism of; 22. Kidney, Inflammation of Pelvis of; 28. Kidney, Suppurative Inflammation of; PERINEPHRITIS; and SURGICAL KIDNEY.

2. **Kidney, Acute Atrophy of.**—DEFINITION.—This is a rare disease of the kidney, consisting in rapid exudation into the cells of the organ, followed by fatty degeneration and disintegration; caused by unknown conditions; characterised by the sudden occurrence of copious albuminuria, with very numerous tube-casts, and frequently marked uræmic symptoms; and resulting apparently invariably in death.

ÆTIOLOGY.—The causes of this affection are unknown, but it appears probable that it depends upon some form of blood-poison, the disease being frequently associated with acute atrophy of the liver. In most cases it would appear to follow the hepatic disease; in some it precedes it. It is much more common in the female sex than in the male; and is most frequent during pregnancy and after childbirth.

ANATOMICAL CHARACTERS.—There are two stages in the progress of this disease, namely, (1) that of exudative infiltration and enlargement; (2) that of disintegration and atrophy. In the first stage the organ is enlarged, not markedly congested, the capsule strips off readily, the substance is flaccid, the cortical substance is swollen, the individual tubules are enlarged and white. On section the vessels are found mostly empty of blood, being compressed by the diseased tubules. The tubules are occupied by dense opaque material; and the individual cells are swollen and granular, their nuclei being hidden by molecular cell-contents. The tubules of the cones, as well as those of the cortical substance, are frequently affected. Many of the cells also are in a state of fatty degeneration, or broken down even at this stage. In the more advanced stage the organ is smaller than natural, and its capsule appears wrinkled. The kidney is pale and flaccid. When cut into there escapes a quantity of *débris*, often containing oil-globules, quite visible to the naked eye. The stroma is intact, and sections can easily be made with a Valentin's knife. The sections show that many of the tubules are denuded of epithelium, and that the shrinking of the organ results from this disintegration. It is easy to find different tubules and cells in various stages of transformation, some showing the early stage of cloudy swelling, others the stage of fatty transformation, and others the disintegrating, almost deliquescent condition. The friability of the cells is quite extraordinary, the weight of a thin cover-glass often sufficing to reduce them to molecular *débris*.

It will be observed that the changes, both in the organ and the individual cells, exactly correspond to those met with in acute atrophy of the liver.

SYMPTOMS.—The symptoms characterising this affection have not yet been very fully studied. Diminution of urine, copious albuminuria, with deposit of casts corresponding to the changes in the kidney, are probably the chief renal symptoms. A tendency to hæmorrhages, jaundice, and uræmic nervous affections, and the series of symptoms proper to acute atrophy of the liver, are also observed.

DIAGNOSIS.—There is probably no disease with which acute atrophy of the kidneys is liable to be confounded.

PROGNOSIS AND TREATMENT.—The prognosis must be unfavourable; and no treatment can be of any avail.

3. **Kidney, Albuminoid Disease of.** *See* BRIGHT'S DISEASE.

4. **Kidney, Anomalies of.**—The kidneys may present three kinds of anomaly, namely: in number; in form; in situation. Only the first of these will be referred to here.

Anomalies in Number.—Sometimes one kidney, with the corresponding ureter, is entirely absent. In such cases the organ which is present is much above the normal size. There is generally no symptom present during life, but diseases of the pelvis of the kidney or of the ureter are made more formidable in persons so affected, than in those normally developed.

Occasionally one or more supernumerary kidneys are present. *See* 23. Kidney, Malformations of; and 25. Kidney, Malpositions of.

5. Kidney, Calculus in.—*See* RENAL CALCULUS.

6. Kidney, Cancerous Disease of.—*See* 24. Kidney, Malignant Disease of.

7. Kidney, Chronic Atrophy of.—This condition of the kidney arises under a variety of circumstances, but specially as a consequence of hydronephrosis, and of the different forms of Bright's disease. In hydronephrosis the atrophy commences in the cones, and spreads to the cortical substance. In all the forms of Bright's disease it commences at the surface and spreads inwards. In hydronephrosis atrophy is a result of the pressure of the renal secretion, as it accumulates in the dilated pelvis and within the tubules. In inflammatory Bright's disease it is due to interstitial changes, and the gradual absorption of the contents of the occluded uriniferous tubules. In cirrhotic Bright's disease it is a consequence of the contraction of the hypertrophied fibrous stroma, and the consequent destruction of vessels and secreting structures. In the waxy or albuminoid form it is due to the molecular absorption of the hyaline material and altered cells which occupy the uriniferous tubules, as a consequence of the degeneration proper to the vessels.

ANATOMICAL CHARACTERS. — Although really atrophied, the hydronephrotic kidney appears large, and may form a mass several times the size of the normal kidney. It is lobulated on the surface, and may often be seen to be little more than a group of cysts containing watery fluid. In the earlier stages no change is observed, except flattening of the cones; in the later the cortical substance also is more or less wasted. This condition is usually seen only on one side, the other kidney being natural, or somewhat hypertrophied.

Atrophy from inflammatory Bright's disease is rarely far advanced when the fatal result occurs. Both kidneys are affected, and usually to the same extent. The capsule strips off readily. The surface presents a finely granular appearance. On section, the cortical substance is found relatively diminished. Many of the tubules are occupied by sebaceous-looking material. Many of them are diminished in size, and irregular in outline from absorption of their contents. The stroma is relatively increased, the vessels are little altered.

In the cirrhotic form the atrophy is often more advanced, and is commonly equal, or nearly so, on the two sides. The capsule is adherent, the surface granular and uneven. On section, the cortical substance appears diminished, and it often contains many cysts. On microscopic examination the fibrous stroma is found markedly increased, many of the tubules and vessels are destroyed, while the smaller arteries are thickened.

In the waxy or albuminoid form the kidneys have in some cases been found greatly and nearly equally diminished in size. The capsule strips off readily; the surface is finely granular. On section the cortical substance is found diminished, the degenerated Malpighian bodies remaining singularly prominent, especially towards the surface, the stroma appearing relatively somewhat increased, and the hyaline contents of the tubules in process of absorption.

SYMPTOMS.—No definite group of symptoms indicate the existence of atrophy. Those met with in the atrophic stages of the different affections are described under each disease.

Partial Atrophy of the Kidney results from embolism, new-formations, and other like causes; and is in many instances unattended by symptoms.

8. Kidney, Cirrhotic.—*See* BRIGHT'S DISEASE.

9. Kidney, Congestion of.—*See* 18. Kidney, Hyperæmia of.

10. Kidney, Cystic Disease of.—DEFINITION.—A chronic morbid state of the kidney, caused by conditions not fully ascertained; characterised in some cases by no symptoms, in others by the presence of tumours, and by symptoms resembling those of the cirrhotic form of Bright's disease; resulting in permanent change; and not amenable to treatment. The formation of cysts in the kidney may be unimportant, either from the small number of cysts, or from the co-existence of much graver disease of the kidney; but it may constitute a serious disease.

ÆTIOLOGY.—Nothing is known as to the causes of cystic degeneration of the kidneys. It may be congenital, or may come on during adult life. The mode of origin of the cysts appears to be from the dilatation above obstructed points in the course of the uriniferous tubules, or at their points of origin in the Malpighian bodies. Sometimes the cysts are new-formations in connexion with epithelium; and sometimes they arise from the fibrous stroma of the organ.

ANATOMICAL CHARACTERS. — Renal cysts vary greatly in size, from minute, almost microscopic, cavities, to spaces capable of holding several pints of fluid. The true cystic kidney is large; its surface is uneven, and in colour it resembles a piece of conglomerate. The capsule strips off, but often with some difficulty. On section its substance is found replaced by multitudes of cysts, scarcely any proper tissue remaining. The contents may be watery, or contain urinary constituents, or are tinged with blood, or sometimes are gelatinous or colloid.

SYMPTOMS.—In many cases cystic disease of the kidneys is unattended by any symptoms; and even when the disease is extensive and severe there are, as a rule, no constitutional symptoms until the case draws near its termination. Among local signs the most important is enlargement of the organs, which may sometimes be made out by means of palpation and percussion, in cases which are advanced, and in emaciated subjects. Both organs are generally equally enlarged. The urine is secreted in natural or in excessive quantity; its specific gravity is low; and it contains albumin, and sometimes blood. The termination of these cases is not infrequently abrupt, with uræmic convulsions and coma.

Diagnosis.—The points which are of importance are the presence of bilateral tumour; with copious discharge of urine of low specific gravity, or containing albumin.

Prognosis.—The prognosis is always unfavourable.

Treatment.—Treatment can be directed only to the relief of symptoms.

11. **Kidney, Dropsy of.**—This is a synonym for hydronephrosis, in which urine, more or less altered, accumulates in the renal pelvis, as the result of obstruction of the ureter. *See* Hydronephrosis.

12. **Kidney, Embolism of.**—The impaction of emboli in the branches of the renal arteries gives rise to various lesions, of which the most common is the hæmorrhagic infarction; next to this inflammation and secondary abscesses; and more rarely gangrenous inflammation. These affections often do not manifest themselves during life by any distinct symptoms; or their existence may be revealed by sudden albuminuria and hæmaturia, and sometimes by general constitutional disturbance and local pain.

Ætiology.—The chief cause of renal embolism is disease of the valves of the heart. The emboli may be composed of coagulated fibrin; or of fragments of the tissue of the valve, which have been separated by ulceration. More rarely embolism is caused by fibrin which has coagulated between the meshes of the fleshy columns of the heart, or by coagula which have formed on the roughened inner coat of arteries. Among the remoter causes are those of endocarditis and endarteritis. This, in so far, corresponds with the name which Rayer applied to these infarctions—'rheumatismal nephritis.'

Anatomical Characters.—(*a*) *Of hæmorrhagic infarction.*—This may, for convenience, be described as passing through three stages: (1) that of red consolidation; (2) that of fawn-coloured transformation; and (3) that of absorption or atrophy. The form of the masses is usually conical, or, as seen on section, wedge-shaped, the base being towards the surface. At first a patch is deeply congested, and presents a dark red colour. On microscopic examination the vessels are found congested, many ruptured; and blood is extravasated into the tubules. In the second stage this redness has passed away; a buff or fawn-coloured mass represents the red patch of the earlier stage. On microscopic examination the cells of the tubules are found to be destroyed, and within them, as well as in the stroma, blood-pigment may be found. In the third stage there is commonly a depression of the surface of the organ; and, on section, what had been the conical patch is represented by a fibrous cicatrix.

(*b*) *Of abscesses.*—In certain cases, especially in the course of pyæmia, emboli lead to the formation of abscesses. Such abscesses will be found throughout the kidney, and may be traced in various stages, which might be described as red consolidation, ashy-grey consolidation, and suppuration. In this condition the clot will not be found at the apex of the cone of disease, but imbedded within it. Between the simple infarction and the abscess there is an intermediate state—a certain degree of suppuration occurring at the margin of the affected area.

(*c*) *Of gangrenous patches.*—In consequence of the impaction of an embolus, though very rarely, gangrene of the affected district occurs, with more or less suppuration.

Symptoms.—The symptoms of the embolic infarction in the kidney are often very indistinct, but the condition may sometimes be diagnosed. For example, if in a case of valvular disease of the heart or extensive calcareous affection of the arteries, sudden albuminuria or hæmaturia, with some degree of fever, and pain in the region of the kidneys, occurs, there is every reason to conclude that an embolus has been impacted. This condition is rarely one of importance in the case, for much graver maladies co-exist with it. The occurrence of embolic abscess in the kidney may sometimes be surmised when sudden albuminuria or hæmaturia becomes superadded to the other symptoms of pyæmia. Gangrene of the kidney or a portion of it is not likely to be capable of diagnosis during life.

Diagnosis.—The diagnosis of renal infarction turns upon the points above referred to. It is important to distinguish it from Bright's disease, and from passive congestion. From the former it is distinguished by the suddenness of the onset, the shortness of its duration, the absence of renal dropsy, and the presence of cardiac or vascular disease; from the latter by the suddenness of its development, and by the absence of signs of stasis in other organs.

Prognosis.—The prognosis in cases of infarction is favourable so far as the kidneys and their functions are concerned, but unfavourable in this respect, that there is a tendency to the impaction of emboli in other more important parts, particularly in the brain.

Treatment.—No special or particular treatment can be directed to this condition.

13. **Kidney, Fatty Disease of.**—Definition.—A chronic affection of the kidney, consisting in simple fatty degeneration

of, or infiltration into, the renal epithelium, without inflammation; characterised by no symptoms as yet clearly ascertained.

ÆTIOLOGY.—Fatty kidney results in some cases from long-continued exhausting disorders; from senile marasmus; from starvation; from poisoning with phosphorus; and perhaps from excessive indulgence in fatty food.

ANATOMICAL CHARACTERS.—The kidneys are of about the natural size, their surface is smooth, and the capsule strips off readily. There is no congestion, and scarcely any stellate veins are visible. The organ is more soft and flexible than natural, and the surface is mottled with numerous deposits of sebaceous-looking material. On section the relative size of the cortical substance and the cones is seen to be preserved; and beyond a general pallor there is no change except the abundant deposition of sebaceous-looking material, mostly in the tubules of the cortical substance, but also in those of the cones.

On examining a section with a low power of the microscope, the characteristic fatty opacity is well-marked, and by careful scrutiny it may be generally made out that the fatty material is not in the canal of the tubule, but within the epithelial cells. The Malpighian bodies, the vessels, and the stroma, under a higher power, appear natural; and, in transverse section of the tubules, a clear lumen may be made out. It will thus be observed that there is no inflammatory desquamation of the cells, nor exudation filling up the lumen of the tube.

SYMPTOMS.—Little is known of the clinical features of this affection. But the quantity of the urine appears to be diminished. There is certainly no albuminuria, and apparently no other important change in its composition. Dr. Lang, of Dorpat, has shown that a little free oil is sometimes found in the urine.

DIAGNOSIS.—It is scarcely possible to diagnose this affection with certainty; but diminution of the urine, without albuminuria, and with the presence of oil in the urine, especially if associated with the signs of fatty liver, and with any of the known causes of fatty degeneration, may lead to the establishment of the diagnosis.

PROGNOSIS.—The renal affection is not generally an important element in the prognosis, other conditions of more importance being present.

TREATMENT.—General tonic treatment, and the removal of the cause when known, are the only indications.

14. Kidney, Gouty.—This is a form of contracted granular kidney, occurring in gouty subjects, and attended with the deposit of urates in the renal tubules. *See* BRIGHT'S DISEASE; and GOUT.

15. Kidney, Granular.—A synonym for a chronic form of Bright's disease, where the kidney presents a granular appearance. *See* BRIGHT'S DISEASE.

16. Kidney, Hæmorrhage in connexion with.—Blood may escape into the substance of the kidney, as the result of embolism or injury; into the tubules, giving rise to blood-casts; or into the renal pelvis, especially from injury to the mucous lining by calculi. The only diagnostic indication of this event is the presence of blood in the urine, intimately mixed with it, or sometimes in clots. A coagulum of blood may block up the ureter. *See* HÆMATURIA; and HÆMOGLOBINURIA.

17. Kidney, Hydatid-Disease of.—DEFINITION.—A chronic parasitic disease of the kidney, caused by the reception into the system of the ova of the Tænia echinococcus, and the development in the kidney of the corresponding cystic form; consisting in the formation of hydatid cysts—'echinococcus hominis'—in the substance of the organ; characterised in some cases by no symptoms, in others by renal tumour, or by the discharge of cysts with the urine, after symptoms resembling those of renal calculus; and resulting sometimes in recovery, sometimes in death, either by perforation into the lung, intestine, or other part, or by suppuration.

ÆTIOLOGY.—*See* ENTOZOA.

ANATOMICAL CHARACTERS.—The affected organ is enlarged, sometimes greatly. It is often connected by adhesions to neighbouring parts. A globular tumour projects from the surface, and extends into the substance of the kidney, inducing corresponding atrophy. The cyst has an outer covering of fibrous tissue derived from the organ; and an inner coat—the cyst proper, which may be barren, that is, devoid of daughter-cysts, or may contain within it numerous smaller cysts and processes growing inwards from the walls, containing scolices which may give origin to the corresponding tape-worm. In either case the cyst-wall is somewhat tensely expanded by a clear liquid, rich in chloride of sodium. The cyst enlarges gradually, and may burst in various directions, but most frequently into the pelvis of the kidney, or into the lungs and bronchi. Sometimes suppuration of the cyst occurs, and accordingly one finds on *post-mortem* examination the remains of a shrivelled and sunken cyst, with caseated contents, in which are imbedded remains of daughter-cysts and hooklets from the scolices.

SYMPTOMS.—The course of hydatid-disease of the kidney is always chronic. It may be prolonged for many years. The advance is insidious. Attention is sometimes drawn first to the presence of a tumour, sometimes to the evidences of its rupture. When rupture takes place into the pelvis of the kidney, daughter-cysts passing along the ureter give rise to symptoms resembling those of renal colic; but the discharge of the cysts, and the results of the microscopic examination, reveal the true cause of the irritation. After such a discharge the cyst may atrophy; sometimes it happens that a second or even a third discharge occurs after a shorter or longer interval. When the discharge is by the lung, pain and cough occur, due to irritation of the pleura; then the expulsion of the hydatids takes place; sometimes this also results quite favourably. The special features of a hydatid tumour are its globular form and its elasticity. When suppuration occurs, fever supervenes, attended with local pain.

Diagnosis.—The diagnosis of hydatid of the kidney depends upon the presence of a tumour of a special kind; and is made certain by the discharge of cysts or hooklets.

Prognosis. — The prognosis is always doubtful.

Treatment. — Medicine is of no avail. The best treatment is the removal of the fluid contents of the cyst by aspiration. When such removal is successfully effected, the parasites in many instances die, and the cyst shrivels up.

18. Kidney, Hyperæmia of.

Definition.—An acute or chronic affection of the kidney, consisting in active or passive congestion of its vessels, with secondary changes; characterised by the appearance of albumin, and sometimes of blood and of hyaline tube-casts in the urine, the quantity of urine being generally diminished, and its specific gravity natural; resulting in recovery if the cause be removed, but in the passive form commonly continuing or recurring till the fatal result is induced, partly by the original, and partly by other causes.

Ætiology.—*Active* congestion — that is, congestion due to increased influx of arterial blood—may be caused by inflammation; by various blood-poisons, such as those of scarlet fever, measles, typhus; and by some medicinal substances, such as cantharides, turpentine, cubebs; also probably by agencies which paralyse the muscular fibres of the small arteries—as is sometimes seen in the course of exophthalmic goître, or which increase the blood-pressure in the renal arteries. *Passive* congestion, which implies congestion due to hindrance to the efflux of venous blood from the organ, may be caused by any obstruction to the circulation. It is most commonly met with in cases of cardiac disease where the right chambers of the heart are dilated. It also results from such diseases of the lungs as are followed by dilatation of the right side of the heart—for example, emphysema. It also sometimes arises, though much more rarely, from obstruction in the course of the inferior vena cava, or in the renal veins, as from pressure of aneurysmal or other tumours, or from the formation of a thrombus.

Anatomical Characters.—In the *active* form of renal hyperæmia, the anatomical changes are probably less marked after death than during life. The kidneys are generally of fully the normal size; the capsule strips off readily; and the surface is smooth. On section the vessels are found congested; the Malpighian bodies frequently standing out prominently, being distended with blood. The vessels of the cones are also overfilled. More or less evidence of inflammatory change is to be found in the tubules, the epithelium being granular and opaque, and the lumen of the tubules, especially those of the cones, being filled up with coagulated fibrin. Blood is sometimes found extravasated into the convoluted tubules. The stroma is unaltered. Sometimes there is congestion of, or even extravasation into, the mucous membrane of the pelvis of the kidney and of the ureter. In *passive* congestion the anatomical changes are more marked, and vary with the duration and intensity of the affection. In the slighter forms, or in those of short continuance, the kidney is of fully the natural size; its capsule strips off readily; the surface of the organ is smooth; and there is evidence of congestion. On section, the congestion is seen to occupy the veins and the Malpighian bodies; sometimes there are evidences of extravasation of blood; and sometimes fibrinous coagula are found in the tubules.

In the more chronic forms, although the capsule strips off readily, the surface is somewhat uneven; congestion is still marked on the surface, but scarcely so distinctly as in the earlier stage. On section the organ feels firmer than natural; it is in a condition which may be best described by the term 'induration.' Its small veins and Malpighian bodies are dilated and full of blood; the fibrous stroma is relatively increased, especially towards the surface of the organ; some of the tubules are wasted, some are blocked up with exuded material, and some exhibit evidence of disintegration and fatty degeneration of the epithelium. The condition of the stroma thus approaches that of cirrhosis of the kidney; the condition of the tubules approaches that of inflammation. There is no definite boundary line between the conditions anatomically; still the combination of the changes confirms the inference which must be drawn from the study of the clinical history, that these hyperæmic changes, though approaching to, are not identical with, the processes properly included under the term 'Bright's disease.'

Symptoms.—The symptoms of *active congestion* are the presence of albumin in the urine, occasionally accompanied by hyaline tube-casts, and sometimes by blood in greater or less quantity. It occurs commonly as a transient, or occasionally as a recurring condition; and, unless when it betokens a commencing inflammatory action, is rarely of much practical importance.

In *passive congestion* albuminuria is again the leading symptom; the urine is generally somewhat reduced in quantity, of about normal specific gravity, often of acid reaction, depositing urates. The amount of urea is little below the normal. Tube-casts are usually scanty, and may be wanting; when present they are hyaline or sometimes bloody, and occasionally contain altered epithelium.

Diagnosis.—The question relating to diagnosis, which is of most practical importance, lies between hyperæmia and inflammatory Bright's disease. In making this distinction, the points to which we have to attend are the general condition of the patient, in respect to the possible causes of such an affection, the presence of cardiac or pulmonary disease, or of venous obstruction. In congestive affections the urine is scanty, as it often is in Bright's disease, but it is of high colour, of natural specific gravity, and rarely contains blood, renal epithelium, or tube-casts.

Prognosis.—The prognosis depends entirely upon the conditions inducing the congestion. In the active form it usually rapidly subsides; in the passive form, it is persistent, or at best, if temporarily got rid of, is almost sure to recur.

Treatment.—When the renal congestion is very intense, dry cupping, local bloodletting, the hot air or the warm vapour bath, or warm applications over the kidneys, may be indicated; but the treatment is mostly that of the diseases which are inducing the congestion. Thus, in the case of cardiac disease digitalis and iron, in the case of pulmonary disease digitalis with squill, and, if necessary, a little blue pill or carbonate of ammonium, are indicated. The general management should be that proper to the obstructive disease which has induced the congestion.

19. **Kidney, Hypertrophy of.**—True hypertrophy, that is to say, increase of all the elements, or of the essential elements of the kidney, occurs only in one organ as a rule, and that by way of compensation for atrophy of the other.

Simple increase of bulk of the kidneys often results to a certain extent from congestion, inflammation, the various forms of Bright's disease, new-formations, and accumulation of the secretion.

Anatomical Characters.—These present no peculiarity beyond the enlargement, the organ weighing sometimes eight or nine ounces, the renal artery and vein being proportionately enlarged, with a corresponding coarseness of structure.

Symptoms.—Hypertrophy of the kidney is without symptoms, but it might so happen that the enlargement of the organ could be detected on physical examination.

20. **Kidney, Infarction in.**—*See* 12. Kidney, Embolism of.

21. **Kidney, Inflammations of.**—Inflammation of the kidneys and their pelves presents many varieties. The kidneys themselves exhibit, first, tubular inflammation, acute or chronic; second, inflammation of the stroma, acute or chronic; third, suppurative inflammation of the substance of the organ, septic or non-septic. The renal pelvis is also liable to acute or chronic inflammation. It will serve no useful purpose to discuss these in a general article, and therefore the reader is referred to the several special articles. *See* Bright's Disease; 28. Kidney, Suppurative Inflammation of; and 22. Kidney, Inflammation of Pelvis of.

22. **Kidney, Inflammation of Pelvis of.**—Synon.: Pyelitis; Fr. *Pyélite*; Ger. *Nierenbeckenentzündung.*

Definition.—An acute or chronic disease of the pelvis of the kidney, caused by extension of inflammation or irritation from the neighbouring parts, by renal calculus, by cold, or by blood-poisoning; consisting in inflammation of the mucous membrane, frequently associated with changes in the other coats and in neighbouring parts; characterised by the presence of mucus or pus in the secretion, with local pain, and more or less constitutional disturbance; sometimes resulting in recovery, sometimes in long-continued illness, and occasionally in death.

Ætiology.—Pyelitis is caused by:—(1) extension of inflammation from neighbouring parts of the urinary tract—sometimes from the kidneys, sometimes from the bladder; (2) stagnation and decomposition of the urine in the renal pelvis; (3) mechanical irritation, as from calculi and gravel; (4) exposure to cold; (5) certain blood-poisons, such as those of septicæmia, diphtheria, and typhus; and (6) the action of certain other poisons.

Anatomical Characters.—Three types of pyelitis may be recognised, namely:—(*a*) the *acute*; (*b*) the *chronic*; and (*c*) the *calculous*.

(*a*) *Acute.*—The mucous membrane is congested, and its surface coated with mucus, sometimes with a bloody, sometimes with a diphtheritic, layer. The membrane itself may be more or less extensively destroyed; and the characteristic tailed epithelial cells of the pelvis of the kidney may be thrown off in large numbers. Besides these cells, the cavity contains mucus or muco-purulent material in quantity.

(*b*) *Chronic.*—In this condition the mucous membrane is much thickened, often of a slate-grey colour, with ecchymoses, and sometimes with ulcerative abrasions of the surface. The other coats of the pelvis and the ureter may also be distinctly thickened, and the lumen of the ureter may be more or less narrowed. The cavity contains purulent material, with *débris* of broken-down mucous membrane; and sometimes, the ureter being obstructed, great accumulation of pus takes place, so as to expand the pelvis and lead to partial atrophy of the kidney (*pyonephrosis*).

(*c*) *Calculous.*—In this form the mucous membrane may present either of the conditions above described, but one always finds mingled with the other contents calculi of greater or less size.

Symptoms.—The symptoms of *acute* pyelitis may be either well-defined or masked. There may be uneasiness or acute pain in the loins and along the line of the ureter; sometimes distinct rigors, with other febrile symptoms, occur; and the urine is cloudy, depositing mucus or muco-purulent material, or sometimes blood. The most characteristic feature is the presence in the urine of the angular tailed cells which line the pelvis of the kidney. The condition may gradually subside, or may become chronic; or in rare cases, and where important complications exist, it may prove fatal.

In *chronic* pyelitis there is often an aching feeling, or well-defined pain, in the region of the ureters. There is constitutional disturbance, debility, fever, hectic; the urine is opaque, and deposits pus—generally grey, sometimes tinged with blood. This condition may go on for long periods, sometimes terminating in recovery, but often persisting and proving fatal by exhaustion, by extension to the kidney-substance or to the surrounding cellular tissue, or by concomitant complications.

The *calculous* differs from the other forms in respect of its cause; and in being attended by more pain, by more tendency to hæmorrhage, and sometimes by the presence of crystals, gravel, or calculi in the deposit.

If the escape of the pus should be prevented in any of the three forms of pyelitis, owing to obstruction of the ureter, and pyonephrosis result, a fulness or fluctuating tumour may be detected in the renal region, and this in some instances subsides at intervals, with a copious discharge of pus in the urine.

Diagnosis.—From cystitis, pyelitis is distinguished by the absence of vesical pain, and of frequent calls to micturition; and by the presence of the lumbar uneasiness, and the more intimate admixture of the foreign materials with the secretion. From renal inflammation it is distinguished by the absence of tube-casts; the seat of the pain; and the presence of the characteristic cells of the renal pelvis. From strumous kidney it is sometimes almost impossible to differentiate simple pyelitis. Indeed, the two conditions are not infrequently associated together; but the presence of other evidences of strumous disease, the enlargement of one or both kidneys, and the discharge of copious *débris*, in addition to the pus, often suffice to distinguish the one from the other.

Prognosis.—In the slighter and acute forms of pyelitis, the prognosis is generally favourable. In the chronic variety it must always be guarded, the amount of danger being determined in some measure by the cause, the constitutional conditions, and the complications.

Treatment.—The first essential is that the patient should have rest, and that the urinary secretion should be copious and bland. In order to secure these ends, a diet largely composed of milk and simple diluents, or in some cases exclusively of milk, and the avoidance of stimulating foods and drinks, are to be insisted on. As to medicine, if the urine be excessively acid, alkalis should be administered; if it be alkaline, mineral acids, or benzoic acid, or a benzoate should be given. Various remedies which appear to diminish irritation, such as uva ursi, pareira brava, buchu, triticum repens, copaiva, and sandalwood oil, ought to be employed. In the more acute cases the application of poultices to the loins, and the internal administration of henbane or opium, or morphine hypodermically, are to be recommended.

In the chronic forms of pyelitis a similar line of treatment should be perseveringly followed; and in cases which owe their origin to the presence of calculi, the remedies appropriate to the diathetic condition should be employed. Astringents may possibly be useful in checking too copious a discharge of pus.

In calculous pyelitis our first effort must be to obtain the removal of the calculus by a copious flow of urine, and to prevent the formation of others by correcting the faults of the system to which their formation is due. But if we are unable to get rid of them, surgical interference is fully warranted, and in many cases this suffices at once to relieve the accumulation of pus, and get rid of the calculi.

23. **Kidney, Malformations of.**—The commonest malformation of the kidneys is *lobulation*, which is a relic of the fœtal condition. Next comes the undue development of one organ. Sometimes there are two pelves belonging to each kidney, or two ureters. A not very rare anomaly is the *horse-shoe kidney*, which consists simply in the union of the two kidneys, by a band of renal tissue, at either end, usually the lower. This abnormality is often attended by anomalies in the arrangement of the ureters and vessels. A very rare condition is that in which there is a *central union* between the two organs, owing to the development of supplementary renal structure opposite their pelves. None of these malformations lead to any important symptoms, except by pressure upon the duct or vessels, under superadded abnormal conditions of the organs themselves, or of neighbouring parts.

24. **Kidney, Malignant Disease of.**—Definition.—A chronic disease of the kidney, caused by the circumstances which induce cancer elsewhere; consisting in the formation of nodules of cancer, or the infiltration of the organ with the new-formation; charac-

terised by a renal tumour, cachexia, and frequently by alteration of the urine; and resulting in death.

Ætiology.—*Primary* renal cancer arises from causes not yet ascertained. It occurs at two epochs of life—namely, in early childhood and in adult age. Children under four years appear specially liable. The male sex is more frequently affected than the female; the right kidney more commonly than the left. *Secondary* cancer of the kidney is most frequently associated with carcinoma of the liver, the stomach, the mamma, the testicle, or the uterus; sometimes of the supra-renal bodies, or the mesenteric glands.

Anatomical Characters.—All the varieties of cancer have been met with in the kidney, but the medullary is by far the most common. It is sometimes primary, sometimes secondary. The *primary* affects usually one kidney, most commonly the right; the organ is often much enlarged, weighing sometimes as much as sixteen or seventeen pounds, and this even in young children. In ten children Sir William Roberts found the average weight $8\frac{3}{4}$ lbs.; in ten adults he found it $9\frac{3}{4}$ lbs. Such large tumours occupy a great part of the abdomen, and push the colon forward. The cancer is in some cases scattered in separate nodules; in others it is infiltrated through the mass. It commences always in the cortical substance, and is developed from the fibrous stroma. In the scattered cases the remaining portions of the kidney are quite sound. The cancer may involve the sub-mucous tissue of the mucous membrane of the pelvis, the ureters, and the veins. The lymphatic vessels and glands also become secondarily affected. Sometimes it affects the peritoneum and colon, and it has even involved the skin.

When the renal affection is secondary, it usually involves both organs, and rarely leads to such enlargement as is seen in the primary disease. It occurs in the form of numerous nodules, developed in the stroma or along the vessels. The remaining renal tissue is commonly healthy, but it may be inflamed or otherwise altered.

Kidney, Sarcoma of.—It is probable that a considerable proportion of the cases from which the description of carcinoma of the kidneys is drawn was really referable to one or other of the varieties of sarcoma—either the more common alveolar form, or the rarer one with striped muscular fibres—*rhabdomyoma*. At the present time it is not possible satisfactorily to mark off a definite clinical history of this group of new-formations.

Symptoms.—The symptoms of primary cancer generally become quite distinct when the disease advances, but in the earlier stages they are very indistinct. The urine itself is, as a rule, natural in quantity, of acid reaction, normal specific gravity and colour; but from time to time blood appears, its amount varying from a mere trace to a very serious hæmorrhage. Sometimes the blood is in clots, and this bleeding may be the earliest symptom. It occasionally happens that carcinomatous elements may be discovered in the urinary deposit, but it is very difficult to identify them.

Examination of the abdomen reveals the presence of a tumour, occupying and extending from the region of the kidney. The tumour is generally nodulated, of tolerably firm consistence, and dull on percussion. The colon lies in front of the mass, which is capable of being tilted forward by pressure on the renal region. When the left kidney is affected, the spleen is displaced upwards. As a rule, there is persistent constipation, and some pain; together with the general symptoms of the carcinomatous cachexia.

Diagnosis.—Carcinoma of the *left* kidney may be confounded with enlargement of the spleen; with perinephric abscess; perhaps sometimes with disease of the mesenteric glands; or with obstruction of the colon, and retention of fæces. From splenic tumour it is distinguished by its lower position, by the absence of the splenic notch, the normal condition of the blood, the presence of blood in the urine, the nodulated character of the tumour itself, and the position of the colon in relation to it. From perinephric abscess cancer of the kidney is distinguished by the absence of fever, and of fluctuation; as well as by the less rapid advance of the disease. From tumours of the mesenteric glands renal cancer is distinguished by its situation, being more towards the side and the lumbar region. The mass also is less nodular than in mesenteric growths, which are composed of groups of glands. From carcinoma of the intestine, with accumulation of fæces above it, it is distinguished by the position of the mass, and by its characters on palpation; as well as by absence of the signs proper to the intestinal disease.

Carcinoma of the *right* kidney may be confounded with tumour of the liver, especially in children; but the presence of a space of clear percussion, more or less extensive, between the liver and the tumour, should remove all doubt. If the diseased kidney touches the liver, reliance must be placed on the symptoms proper to renal or to hepatic disease respectively.

Cancer of the kidney is to be distinguished from tumour of the ovary by its more fixed position, and the history of its growth.

Prognosis.—The prognosis is in all cases unfavourable; the duration varies with the form of cancer.

Treatment. — Treatment is, of course, merely palliative—morphine, belladonna, henbane, applied externally or injected subcutaneously, to relieve pain; ergotin and other preparations of ergot, acetate of lead, and gallic acid to check hæmorrhage; and iron as an astringent and blood-tonic. The bowels require careful attention; and sometimes there may be so much ascites as to warrant tapping. Excision of the affected organ may be attempted in some cases.

25. **Kidney, Malpositions of.** — The kidney may be congenitally displaced, but the important anomaly coming under this head is the *movable kidney*, which demands special consideration.

Definition.—The movable kidney is a condition especially affecting women; consisting in the undue mobility of one, or rarely of both kidneys; characterised in some cases by no symptoms, in others by uneasiness or pain, with general nervous disturbance, and by the presence of a tender reniform tumour, with clear note on percussion in the renal region of the affected side; resulting, as a rule, in frequent recurrence of the symptoms, without danger to life.

Ætiology.—Movable kidney is more common in the female sex, and especially in those who have passed through many pregnancies, but it is not exclusively associated with women, for it occurs (although rarely) in males, and also in children. The right kidney is much more frequently affected—65 out of 91 cases (Ebstein). Its occurrence is probably mainly due to laxity of the abdominal parietes, and unusual length, or irregular distribution, of the renal vessels.

Anatomical Characters.—The kidney is not necessarily changed in its structure, but its position may be altered in any direction.

Symptoms.—In many cases no symptoms occur in movable kidney. But in some cases, whenever the displacement occurs, much uneasiness or even considerable pain is experienced. The writer has known a man unable to work in consequence of the pain induced by the displacement, and losing a day's work regularly once a week or once a fortnight. The sensations are generally rather of the nature of vague uneasiness than of actual pain, except when the organ is touched, and then there is pain of a peculiar and sickening kind. The urine sometimes becomes altered during the attacks, depositing mucus, and in one case in the writer's practice a little blood. On percussion over the renal region posteriorly a clear note may be elicited on the affected side, and sometimes a flattening may be made out at the part. Careful palpation reveals a tumour, of characteristic renal form; and now and then pulsation of the renal artery may be felt. The morbid condition may recur at intervals during many years; in some cases it is apparent for a time, and then absent for a very long period. It is liable to be brought on by effort, but often appears without discoverable cause. Occasionally it is found that the displaced kidney owes its position to the existence of carcinoma or other disease of the organ.

Diagnosis.—The malady may be confounded with tumour of a malignant nature, originating either in the abdomen or in the pelvis. The diagnostic points are—the peculiar tenderness; the mobility; the occasional disappearance; the unchanging character of the tumour; and the occurrence of a clear percussion-note with flattening in the renal region of the affected side.

Prognosis.—The prognosis is favourable.

Treatment.—The treatment should be by means of bandages or trusses to support the abdominal walls, and keep up a pressure upon the kidney, so as to retain it in its normal situation. In the case of the working man above referred to, complete immunity from the displacement was obtained by the use of a bandage with a pad so arranged as to keep up a pressure upon the organ.

26. **Kidney, Morbid Growths of.**—The only really important morbid growths of the kidney are cancer and tubercle. Syphilitic new-formations occasionally occur, but give rise to no characteristic symptoms. Growths of fibrous, fatty, bony, muscular, and glandular tissue have all been met with in a few cases. Hydatid-disease may also be mentioned.

27. **Kidney, Parasites of.**—The parasites which have been described as existing in the human kidneys are hydatids (*see* 17), strongylus gigas, pentastoma denticulatum, bilharzia hæmatobia; also the larval form of the filaria sanguinis hominis, which inhabits the lymphatic vessels, either of the kidneys themselves, or of some lower part of the urinary tract.

Treatment.—In the treatment of patients affected with bilharzia hæmatobia, the internal use of oil of turpentine, and of the extract of male fern, is recommended. It is stated that, when the bladder is affected, injections of iodide of potassium, twenty or thirty grains dissolved in tepid water, repeated every second or third day, have been found useful. *See* Entozoa; Chyluria; and **17.** Kidney, Hydatid-Disease of.

28. **Kidney, Suppurative Inflammation of.**—Definition.—An acute or subacute disease of the kidneys; caused by injuries, extension of disease from the bladder, and perhaps exposure; consisting in inflammation and suppuration in the kidney; characterised by constitutional disturbance, with local pain or tenderness, and various alterations of secretion; and usually resulting in death.

Ætiology.—The commonest causes of this disease are renal calculus, leading to inflammation of the pelvis of the kidney; and inflammation of this part, propagated upwards from the bladder or urethra. Next in frequency is pyæmia, which induces metastatic abscesses. Comparatively rarely the inflammation is a result of embolism of the renal arteries; of injuries; and perhaps of exposure to cold.

Anatomical Characters.—The affected organs are generally above the natural size. The capsule may strip off readily, but often this process leads to tearing of the substance, and liberation of pus. The surface is frequently discoloured in patches. The abscesses may be described as passing through several stages. There is first the stage of congestion, with exudation into the stroma of the organ; secondly, the stage of grey consolidation; and thirdly that of suppuration. Occasionally sloughing occurs. Sometimes perinephric abscess results, from perforation of the capsule. Drying up of the pus, with shrivelling of the affected area, is sometimes met with.

Microscopic examination reveals in some cases at an early stage the presence of colonies of bacteria in certain districts within the tubules, causing irritation first in them, then in the stroma, and thus inducing suppuration.

Symptoms.—The most important clinical features of suppurative nephritis are the constitutional disturbance, accompanied by pain in the region of the kidneys, and tenderness on pressure, with scantiness of secretion; the urine being albuminous or bloody, or sometimes purulent, and depositing tube-casts.

Diagnosis.—From pyelitis, suppurative inflammation of the kidneys is distinguished by the presence of tube-casts, and the absence of the characteristic angular cells of the calices of the pelvis. From perinephritis, it is diagnosed by the absence of distinct tumour, and by the history of the case.

Prognosis.—The prognosis is generally grave.

Treatment.—The strength should be supported by suitable food, by tonics, and stimulants when necessary; and in some cases benefit may be derived from poulticing, fomentations, or the application of leeches. Under suitable conditions it might be desirable to open a renal abscess, and evacuate the pus.

29. Kidney, Syphilitic Disease of.—Syphilis may produce in the kidney, as in other organs, congestion; inflammation—either simple or gummatous, with the cicatrices and nodules resulting therefrom; and waxy or amyloid degeneration.

Anatomical Characters.—There is scarcely ever an opportunity of studying the appearances of the syphilitic kidney in cases of congestion—probably over-filling of the vessels, with slight inflammatory conditions of the tubules, is all that would be found. The simple interstitial inflammation is characterised by thickening and swelling of the fibrous stroma, in patches here and there. Gummatous inflammation is rare; but when it does occur, it forms masses of the ordinary gummy character. Either of these conditions may lead to the formation of syphilitic cicatrices, which may appear on the surface of the organ, or be imbedded in the cortical substance. Their formation is attended by the destruction of tubules in the affected parts.

Symptoms.—Albuminuria, slight in amount and of temporary duration, occurring along with other syphilitic congestive affections, has appeared to the writer to indicate renal congestion. Various slight cases of inflammatory Bright's disease have appeared to be due to the syphilitic poison. The symptoms of the interstitial and gummy inflammations are not ascertained, although probably albuminuria attends them also. For the symptoms of waxy degeneration, *see* Bright's Disease.

Diagnosis.—The diagnosis of syphilitic disease of the kidney depends upon the coexistence of renal symptoms with evidences of syphilis, while other diseases of the kidney are excluded.

Prognosis.—This is favourable so far as danger is concerned, except in the case of severe waxy degeneration.

Treatment.—Iodide of potassium has been found to be useful in this as in other syphilitic affections, at least in the congestive and inflammatory conditions. Should it fail to give relief, the perchloride of mercury may be given in moderate doses, and continued cautiously even when albuminuria is present.

30. Kidney, Tuberculosis of.

Definition.—A chronic disease of the kidneys and ureters; caused by tubercular infection, or by strumous inflammation of the structures involved; consisting in the formation of nodules of tubercle, or in strumous inflammation of the substance of the gland, and of the mucous membrane; characterised by some degree of constitutional disturbance, sometimes by renal tumour, and by various alterations of the urine, particularly deposit of caseous purulent *débris*; and resulting usually in death.

Ætiology.—The direct causes of tubercular disease of the kidney are unknown. It is more common in children and young people than in those more advanced in life, but it—especially the scrofulous form—may occur later. Men are decidedly more frequently affected than women. The kidneys are rarely equally involved; the right is commonly worse than the left. One organ may be quite free from disease.

Anatomical Characters.—Under renal tuberculosis are included both tubercle proper and strumous inflammation. Tubercle proper occurs in the form of minute miliary nodules scattered throughout the substance of the organ, as a local manifestation of a general true tuberculosis. Strumous inflammation leads to the formation of larger masses, involving either the mucous membrane of the pelvis of the kidney, or the cortical substance. When the former is its seat, it leads to a thickening of the mucous membrane, commencing in patches which gradually extend and ultimately undergo ulceration. When the cortical substance is affected, the organ becomes enlarged; presents a markedly lobulated surface; and on section conical masses of altered tissue are found to correspond with the prominences of the lobules. Some of them are solid and cheesy; others are softened in the centre; while others are completely softened, so that on section a quantity of puriform *débris* flows out, leaving a cavity with white walls, rendered shaggy by the shreds of fibrous tissue which project from them. Sometimes scarcely any renal structure is left. Occasionally what remains shows the characters of waxy degeneration. The disease commences in the stroma of the organ; the tubules are compressed, but are rarely the seat of inflammatory changes. When the mucous membrane of the pelvis of the kidney and the ureter is affected, the membrane is thickened at certain parts, and afterwards becomes ulcerated; and the lumen is diminished, or completely choked up by granular *débris*. Frequently both the mucous membrane and the substance of the kidney are affected. It occasionally happens, when one kidney is exclusively affected, that shrinking of the gland takes place; and a putty-like material, rich in cholesterin, or perhaps even calcareous nodules are found, occupying the smooth-walled cavities produced by the disease. Tuberculosis of the ureters, prostate, vesiculæ seminales, bladder, and testicle not infrequently co-exists.

Symptoms.—When tubercle occurs in small nodules in the kidneys it produces no symptoms, and even in the inflammatory form the constitutional symptoms are, in the earlier stages, not very well-marked; but as the disease advances, fever, passing gradually into the hectic type, is developed. The local symptoms may be negative, but there is frequently pain in the affected organ, with tenderness on pressure; and in some cases a tumour may be felt in front, or percussion may reveal an increased area of dulness in one or both renal regions. The secretion may be normal, or even sometimes excessive in quantity, when the disease is not far advanced. It may be acid or alkaline, of fair specific gravity, albuminous, and sometimes bloody. It often contains a puriform material, with *débris* of renal tissue. Sometimes there are masses of cheesy material, which are eminently characteristic, occurring in no other form of disease of the urinary tract. Tubercle bacilli are sometimes demonstrable in the deposited *débris*. Occasionally the urine becomes suppressed, and symptoms of uræmia precede the fatal termination.

Diagnosis.—The evidences on which we rely in the diagnosis of tubercular disease of the kidney, are the presence of pyelitis, combined with signs of tubercular disease in other parts, and above all the deposit in the urine of the characteristic fragments of cheesy tissue above described, and the occurrence of bacilli, although the failure to demonstrate them cannot be held to forbid this diagnosis.

Prognosis.—The prognosis is very unfavourable, on account both of the local and of the constitutional conditions.

Treatment.—The treatment is merely palliative—to relieve pain or uneasiness; and to seek to improve the general health, by administering remedies which are useful in strumous affections.

31. **Kidney, Tumour of.**—Any enlargement connected with the kidney, which reveals itself on clinical examination, is regarded as a renal tumour. This may be due to mere hypertrophy of the organ; any form of cystic disease; accumulation of any fluid in the renal pelvis, or in the kidney itself; or a solid new-growth, especially malignant disease. For a description of the signs of these several conditions, the reader is referred to their respective headings in this article; and to other appropriate articles.

T. Grainger Stewart.

KIESTEIN (*κύω*, I am pregnant; and *ἐσθής*, a pellicle).—Synon.: Fr. *Kyestéine*; Ger. *Kyestein.*—This substance was formerly believed to be peculiar to, and always present in, the urine of women in pregnancy, and it was held, therefore, to be significant of that condition. It is usually detected between the second and seventh months. It may, however, be absent during the whole period of pregnancy, as also at the beginning and at the end of pregnancy. It is also met with in the urine of non-pregnant, anæmic patients, under other conditions apart from gestation; and even in the urine of men. It therefore possesses no diagnostic value.

If urine capable of yielding kiestein be set aside in a tall glass, a cotton-wool-like flocculent precipitate becomes visible in the middle of it on the second or third day. This soon rises to the top, and an iridescent pellicle is seen forming on the surface. When this has fully formed, it begins to fall through the fluid in the form of flocculi, until the whole is deposited at the bottom as a whitish layer. Another pellicle containing triple phosphates succeeds this, and putrefactive changes proceed. Fat, mucus, crystals of triple phosphate, vibriones, and granular matter have been detected in kiestein.

Alfred Wiltshire. John Harold.

KINÆSTHESIS (*κινέω*, I move; and *αἴσθησις*, sensation).—The sense of movement.

This endowment is one of great importance in reference to the mode of production of voluntary movements; in reference to the real nature of the functions performed by the so-called 'motor area' of the cerebral cortex; and also for the proper comprehension of aphasia and other speech defects.

Every time a movement is executed we receive a group of sensorial impressions occasioned by and peculiar to the particular movement. This group of kinæsthetic impressions is made up in part of impressions emanating from the muscles in action, of others emanating from the joints moved, and of others coming from tendons, fasciæ, and skin. As some such complex group of sensations or impressions occurs in association with every movement, they may best be described as 'sensations of movement,' with the understanding that they pertain to a distinct kind of sensorial endowment—a sense of movement—kinæsthesis.

These groups of sensations are registered as groups in definite portions of the cerebral cortex, and are capable of being revived in memory like other sensorial impressions. When so revived they constitute (with other related revivals in the visual centres) our 'ideas of movements.' A revival of such an idea must always constitute the first stage in the re-initiation of any voluntary movement that we may desire to perform.

Part of the group of kinæsthetic impressions belongs to what is known as touch and common sensibility, but the most important part of all is composed of what are called 'muscular sense' impressions, coming from the different muscles, and giving information as to their several degrees of tension or contraction. Thus, it is by means of kinæsthetic impressions (*a*) that we are made accurately acquainted with the position and movements of our limbs, (*b*) that we judge of weight and resistance, (*c*) that we derive information and guidance during the performance of movements, and (*d*) that we are enabled volitionally to re-initiate similar movements by the ideal recall of impressions excited by past movements.

Kinæsthetic impressions pass up through the spinal cord and the bulb; thence they pass through the posterior part of the internal capsule, and, as the writer has endeavoured to show elsewhere, they are registered in the Rolandic area of the cortex. The so-called 'motor centres' in the cortex are, in fact, rather sensory centres of kinæsthetic type, in which the effects of movements are registered, and in which the ideal recall of movements occurs as an absolutely necessary preliminary to the production of voluntary movements.

Disorders of Kinæsthesis.—From what has already been said, it will be clear that very different disabilities should result (A) from lesions which affect the *paths* for kinæsthetic impressions, either in the cord or in the brain; (B) from those which are produced by disease of the kinæsthetic *centres* in the cortex. The effects of disease of the centres, again, will vary according as they are of a destructive or of an irritative nature. Not infrequently, and especially in hysterical subjects, we get a further complication (C), due to the simultaneous involvement of the cerebral paths and of the centres for kinæsthesis.

A. Where the *paths* for kinæsthetic impressions are damaged, the following defects are more or less marked:—

1. Difficulty in specifying the nature and extent of passive movements, and also as to the position in which affected limbs are left. 2. Difficulty in discriminating differences in weight and resistance when affected muscles are called into play. 3. Difficulty in accurately performing prescribed movements when the eyes are closed, *e.g.* from the abducted position of the arm touching the tip of the nose with the forefinger. These are the kinds of defect which are met with in locomotor ataxy, owing to implication of kinæsthetic paths in the cord; and such paths are sometimes affected altogether out of proportion to other sensory channels. Very similar defects are also met with in some cases of cerebral hemianæsthesia, due to lesions or functional derangements in the region of the posterior part of the internal capsule—that is, in cases where there is a loss of deep as well as of superficial sensibility in the affected half of the body. Paralysis, it should be observed, is not a symptom belonging to either of theso conditions.

The fact of the existence of a loss, partial or complete, of kinæsthetic sensibility can often only be established when great care is taken; and the difficulties are greater in the way of our diagnosing such a defect in the leg than they are in the arm and hand. The kind of tests to which we must submit the patient (who must be blindfolded) for the recognition of such defects, are these: We must investigate (*a*) his ability to discriminate differences in weight; (*b*) his ability to recognise and describe the position in which a limb is left after passive movements; this may sometimes best be judged by his ability to put the opposite sound limb in a similar position, or by telling him to touch with the sound hand some named part of the affected limb; (*c*) his ability to move the affected limb quickly and accurately in some specified manner.

B. Disease affecting the kinæsthetic centres in the cortex rather than the mere paths for kinæsthetic impressions gives rise to all the symptoms produced by affection of the paths for transmission *plus* certain others, which will vary according as the lesion is of a destructive or of an irritative nature. Thus, a *destructive* lesion in some of the kinæsthetic centres will cause loss of muscular sense in the related parts, together with a motor paralysis in the same parts. On the other hand, *irritative* lesions of the same kinæsthetic centres will cause diminution of muscular sense, together with spasms or convulsions in related parts, of the kind met with in 'Jacksonian epilepsy.'

Where this morbid condition of the kinæsthetic centres is functional rather than structural, the effects are most frequently akin to those resulting from destructive lesions of the same parts, and we then have to do with various kinds of functional or *hysterical paralysis of cerebral type*, with which there is the association of loss of muscular sense in the affected limbs.

If the kinæsthetic centres are the seats for the registration of the sensation resulting from movements and for the ideal recall of movements, and if such ideal recall is the first step in the initiation of voluntary movements, it seems clear that disease of these centres, whether structural or functional, when it renders such recall impossible, must necessarily render the performance of the corresponding movements also impossible. Similarly, in accordance with the above-mentioned views, the irritation of such centres should lead to the production of spasms or convulsions in related parts of the body.

C. In hysterical subjects, however, another grouping of symptoms is frequently met with, because in them a simultaneous affection of the cerebral paths and of the centres for kinæsthetic impressions is common. That is, we seem to have the more common affection of the cerebral paths for kinæsthetic and other sensory impressions (due to functional disabilities in the posterior part of the internal capsule) associated with a similarly degraded condition of functional activity in the kinæsthetic centres themselves, or some of them, on the affected side. The result is the coexistence of a well-marked hemianæsthesia (superficial and deep) with paralysis of one or both limbs on the affected side. In one very peculiar sub-class of these cases the paralysis only exists when the eyes are closed; the simplest movements cannot then be made, though they are at once capable of being performed as soon as the eyes are opened.

Treatment.—Where kinæsthetic defects are associated with organic disease, either of the spinal cord or of the brain, the treatment to be adopted is that suitable for the diseases in question and the general condition of the patient; and, similarly, when kinæsthetic defects constitute part of the symptomatology of some functional or hysterical malady, we must address ourselves to the relief of the patient's general condition as the best means of ameliorating the special symptoms. We must not forget, however, the special potency of applications of the wire-brush for the restoration of all modes of defective sensibility in cases of functional hemianæsthesia.

H. Charlton Bastian.

KIN-COUGH (Dutch, *Kinkhoest*). Also *Chin-cough.*—Both these words are synonyms for whooping-cough. *See* Whooping-Cough.

KING'S EVIL.—A popular name for scrofula, originating in a belief formerly held that the disease could be cured by the king's touch. *See* Scrofula.

KISSINGEN, in Bavaria.—Common salt waters. *See* Mineral Waters.

KLEPTOMANIA.—Insanity characterised by an irresistible impulse to steal. *See* Insanity, Varieties of: 9. Legal Insanity; and Crime, Irresponsibility for.

KREUZNACH, in Germany.—Common salt waters containing iodine. *See* Mineral Waters.

KYPHOSIS (κυφός, bent).—A synonym for angular deformity of the spine. *See* Spine, Diseases of.

L

LABIO-GLOSSO-LARYNGEAL PARALYSIS (*labium*, a lip; γλῶσσα, the tongue; and λάρυγξ, the throat).—There are two common forms of this disease, which have to be considered separately, namely (*A*) a **chronic** form; and (*B*) a **sudden** form—the latter is often termed 'acute,' but is, as a rule, sudden in onset. (*C*) A true **acute** (not sudden) variety is met with in rare instances. A fourth variety (*D*), **pseudo-bulbar** paralysis, presents many of the symptoms of bulbar disease, but the lesion is seated in the cerebral hemispheres. It will be convenient to describe the common chronic form first.

(*A*) **Chronic Labio-Glosso-Laryngeal Paralysis.**—Synon.: Fr. *Paralysie Glosso-labio-laryngée* (Trousseau); Ger. *Progressive Bulbarparalysie* (Wachsmuth).

Definition.—A progressive symmetrical paralysis of the lips and adjacent facial muscles, of the tongue, pharynx, and sometimes also of the larynx; with or without conspicuous wasting; and often associated with muscular atrophy elsewhere.

History.—First described by Du Mesnil

in 1857, and by Duchenne in 1860, the disease was made generally known by Trousseau's *Lectures*, published in 1863. By the latter writer it was termed 'labio-glosso-laryngeal paralysis,' but it is now generally known by the name, first given to it by Wachsmuth in 1864, 'progressive bulbar paralysis.'

Ætiology.—Of the causes of the affection little is known. It is a disease of later life, being almost unknown under forty. Exceptional cases have been met with in early adult life, and even in late childhood. In the latter instances several members of a family have been known to suffer, and a congenital tendency to early failure of vitality in the structures concerned may reasonably be assumed. In the common form, males are affected more frequently than females. The disease, as such, does not appear to be inherited, but in many cases there is a family history of other affections of the central nervous system. Of immediate causes, exposure to cold, mental anxiety, and defective nourishment have been supposed to exert an influence in some cases.

Anatomical Characters.—When, as is commonly the case, there is wasting of the paralysed parts, their muscles are reduced in size, and present changes similar to those met with in the limbs in chronic spinal atrophy. Their substance is pale; fatty tissue may be in excess; and the muscular fibres often, but not always, present granular degeneration. They are frequently narrowed, and the tissue between them may be increased in quantity, and may contain pigmentary and other products of degeneration, and an increased number of nuclei. When there is no apparent wasting, this may be merely because the interstitial fat compensates for the reduction in bulk of the muscular fibres. Very rarely the structure of the muscles presents little alteration. The motor nerve-fibres are grey, translucent, and, under the microscope, degenerated. Their nuclei of origin in the medulla oblongata are also diseased. The motor cells are shrunken and atrophied; their processes are lost; and the intermediate tissue is degenerated. The hypoglossal nucleus is examined most readily, and the change in it is striking, as well as in the nucleus of the spinal accessory (palate and larynx); it may often also be seen in the nuclei of the glosso-pharyngeal, the vagus, and the 'nucleus ambiguus.' The anatomical change which underlies the affection of the lips has not yet been detected. There is still uncertainty regarding the precise origin of this part of the facial nerve. Most of its fibres diverge from the middle line, close to which the hypoglossal nucleus is situated, and some at least pass towards the lower part of the column of cells, which, above, gives origin to the motor fibres of the fifth nerve. It is certain, however, that a large number of the fibres of the facial descend towards the level of the hypoglossal nucleus. Further, the physiological association of the movements of the tongue and lips is most close. We cannot narrow the tongue without contracting the orbicularis. Hence it is certain that the nucleus for the lower facial muscles and the hypoglossal nucleus, whether blended, contiguous, or distant, are closely connected and are alike predisposed to disease, so that this connected part of the facial suffers in the same manner as the hypoglossal. The fibres passing to these nuclei from the cerebral hemispheres may also be degenerated, and it is probable that these are alone affected in the cases in which there is no change in the muscles. When there is muscular atrophy in the limbs, a corresponding degeneration may be found in the anterior cornua of the spinal cord, often conjoined with sclerosis in the lateral columns, and in the anterior pyramids in the medulla. There is every reason to believe that, in the chronic form, the atrophic changes in the nerve-elements are the primary alteration.

In very rare cases, no morbid appearance has been observed in the medulla. Some of these may have been cases of peripheral neuritis, local and degenerative. In others, in which even the nerve-endings were normal, the degeneration of cerebro-nuclear fibres may have escaped observation, or some toxic influence may have abolished function without causing destructive degeneration.

Symptoms.—The symptoms have the distribution indicated by the name given to the disease by Trousseau, the affected parts being the lips, tongue, throat, and larynx. They are, so to speak, arranged about the tongue as a centre. It is in this organ that the earliest symptoms commonly present themselves, as a trifling indistinctness of speech, due to an imperfect articulation of those sounds in which the tongue is most concerned—especially the dental and palatine explosive sounds, in which the tongue has to be pressed against the teeth or hard palate, *t*, *d*, *k*, *g* (hard), &c. The tongue can be still protruded, although perhaps not quite so far as normal. The lips then become weak, and sounds in which the lips are concerned are imperfectly articulated. The vowels *o* and *oo*, in the pronunciation of which the orbicularis contracts so as to protrude the lips, cannot be well sounded. The lips are not brought together so perfectly, or separated so promptly, as in health, and the labial explosives, *b* and *p*, become *f*, and so does the labial resonant *m*. Whistling is impossible. The lower part of the face loses its expression, the lips are habitually separated, and the saliva cannot be perfectly retained. The difficulty in articulation is soon increased by the weakness of the palate, which ceases to shut off the nasal cavity, so that a nasal resonance accompanies sounds from which it should be absent. The paralysis of the tongue increases until the organ can no longer be protruded. Deglutition becomes impaired, partly (according to Duchenne, wholly) from the weakness of the tongue, but probably in part also from that of the constrictors of the pharynx. The soft palate ultimately hangs motionless, or, if it can be raised a little in an attempt to phonate, during the act of swallowing does not close the posterior nares, so that liquids regurgitate into the nose. Food is apt to lodge in the upper part of the pharynx, and crumbs or liquid to get into the larynx. The laryngeal muscles subsequently become weak, and the glottis cannot be closed. The vocal cords may be equally affected, or one may be paralysed in greater degree than the other. Coughing is necessarily imperfect: air is driven through the larynx, but there is no sudden opening of a previously closed glottis, and hence no explosive cough. In proportion as the glottis is paralysed, phonation is interfered with, but the ability to produce some sound is rarely altogether lost. As the disease progresses, the speech becomes almost unintelligible, being reduced to unarticulated vocal sounds. It is to be noted, however, that the habitual articulation is rarely the best possible. Words can be distinctly articulated by a deliberate effort which are scarcely at all articulated in ordinary speech. The saliva can neither be swallowed nor retained within the mouth, and is constantly dribbling over the lower lip, below which the patient has to retain a handkerchief continually. It has been thought that the quantity of saliva is increased, but the evidence of this is insufficient. The condition of the tongue varies much in different cases. In some it is large, broad, flabby, and soft to the touch throughout. In others it is conspicuously wasted, and covered with wrinkles and furrows from the shrinking. In some cases the lips retain their normal size; in others they are distinctly thinner than natural. This striking contrast between different cases (already referred to) led Duchenne to distinguish two varieties, the *atrophic* and the *paralytic*, but in some of the cases of the latter class it is merely the interstitial fat that prevents wasting from being conspicuous during life. In the affected muscles the electrical irritability is usually little changed: they still contract to the faradic current, even when the atrophy is conspicuous. Sometimes there is an indication of the reaction of degeneration, in undue readiness of contraction to the anodal (positive) closure, or this reaction may be well marked, faradic irritability being much lessened. Other muscles of the head are rarely affected. Those in the upper part of the face always escape, and the zygomatic muscles, with the elevators of the upper lip, are so little affected that their unopposed contracture produces a peculiarly deep and characteristic naso-labial furrow. In many cases muscular atrophy in the limbs, in greater or less degree, is associated, with or without 'contracture.' So, too, in cases of ordinary muscular atrophy, commencing in the limbs, the lips, tongue, and throat are often affected towards the end of the case, in the same manner as in the primary form now under consideration.

Death, in labio-glossal paralysis, is usually the result of asthenia, due, it may be, in part, to the difficulty in deglutition, or to chronic lung disease produced by the repeated entrance of particles of food into the air-passages. Sometimes the patient dies in a paroxysm of coughing, occasioned by an ineffectual attempt to swallow liquids or saliva. There may be a fatal extension of the cerebral mischief.

Diagnosis.—Before labio-glossal paralysis was well known, the difficulty in swallowing was ascribed to a chronic inflammation of the fauces, but this mistake is now scarcely possible. The symptoms have to be distinguished from those due to other diseases of the medulla, and to disease elsewhere. Many sudden lesions, in the region affected in this disease, may cause similar symptoms, but these are distinguished by their onset. Compression of the medulla may also give rise to symptoms of similar distribution, but these are commonly unilateral, or one side suffers before, and more than, the other, and they are often accompanied by a preponderant affection of the muscular part of the spinal accessory, and by great weakness, without wasting, in the limbs. In the 'pseudo-bulbar paralysis,' movements of the tongue are impaired by disease of the cerebral hemispheres. These movements are represented in the lower part of each ascending frontal convolution. When this is diseased on one side, the loss is soon compensated for by the centre in the opposite hemisphere, but a symmetrical bilateral lesion in this situation may cause complete paralysis of the tongue and other parts affected in the disease now described. Such paralysis also is acute in onset.

Prognosis.—The prognosis is most grave. The disease consists in a slow degeneration of the nerve-elements, the effects of which often lead to death in about a year from the onset. Although, in some cases, a temporary arrest may be obtained, and occasionally the malady, after causing a considerable degree of disability, is arrested for several years, it is doubtful whether, in any instance of this form, considerable improvement has occurred. The prospect of prolongation of the state of arrest, if this occurs, depends very much on the amount of care the patient can secure. The older the patient, the less is the chance of arrest.

Treatment.—The degenerative tendency

of chronic labio-glosso-laryngeal paralysis is usually beyond the reach of remedies. Therapeutical efforts must be directed to the endeavour to retard it, by securing freedom from any cause that can be traced, especially from depressing emotion, over-work and the like, by attention to hygiene, improving the general health, and by the administration of nervine tonics, quinine, strychnine, arsenic, nitrate of silver, and the like. Strychnine is most useful when given hypodermically, one injection being given daily, in any convenient place. The nitrate of strychnine is the salt for the purpose; $\frac{1}{100}$ gr. may be gradually increased to $\frac{1}{40}$. Electricity may be tried, although too often it is unsuccessful. Faradisation should be applied to the affected muscles, if they still react to it. Erb has recommended the application of the voltaic current through the throat, the positive electrode being placed on the back of the neck, the negative stroked down the side of the pharynx externally, and such a strength being employed as shall produce reflex movements of deglutition; but the use of central galvanisation is difficult to discern in the experience of most observers. Change of air is desirable in the early stage, and rest is imperative. Food must be carefully regulated; easily digestible varieties being reduced to a semi-solid condition. In the later stages, should swallowing be impossible, nourishment must be administered by an œsophageal tube, or, what is better, by a catheter introduced through the mouth or nose. Belladonna or atropine may, to some extent, check the troublesome flow of saliva.

(*B*) Sudden Labio-Glosso-Laryngeal Paralysis.

—SYNON.: Acute or Apoplectiform Bulbar Paralysis.

DEFINITION.—Paralysis of similar distribution to that of the chronic form, with or without conspicuous wasting, of sudden onset, and due to a vascular lesion.

ÆTIOLOGY.—The causes of this affection are for the most part those which lead to sudden lesions elsewhere in the brain, especially degenerations of vessels, syphilitic disease, and injuries. It is a disease chiefly of late life.

ANATOMICAL CHARACTERS.—Little is known of the exact condition in cases of sudden onset which have recovered with persistent labioglossal paralysis. In cases which have died rapidly, foci of softening in the medulla have been found; and there is reason to believe that such softening, from vascular occlusion, is the most common cause of the condition. Usually there is disease of one of the vertebral arteries, and closure of one or more branches that come off from the diseased part. Sometimes the diseased vertebral is much larger than the other, and its branches have taken the larger share in the blood-supply to the nuclei. Probably a small hæmorrhage may also give rise to it. The frequent symmetry of the symptoms in the sudden form, and their limitation to the parts which are affected in the chronic disease, show the close relation of the central structures, so that they are all affected by the one lesion. The wasting in some of the cases of this variety is very much slower than that which follows an acute lesion of motor grey matter elsewhere. It is possible that the ascending fibres from the nuclei concerned may pass up close to the middle line, in a situation in which all may be damaged by a single lesion, but the bilateral symmetry of the symptoms may also be due to the large size of the diseased vertebral, as explained above.

SYMPTOMS.—The onset is sudden, often with headache and giddiness, rarely with loss of consciousness. The patient suddenly finds a difficulty in swallowing and in articulation, with inability to protrude the tongue. Respiratory disturbances—cough, dyspnœa, and hiccough—may be present. There may be convulsions and weakness in the limbs, sometimes with tingling, but very rarely with loss of sensibility. Many cases which present these symptoms die rapidly in the course of a few hours or days. In those which recover, a paralysis of the tongue, lips, throat, and larynx may remain, resembling that which characterises the chronic form, and there may or may not be conspicuous wasting. In many cases, however, the symptoms are incomplete, some part escapes, or the bilateral symmetry is imperfect. This we should expect from the more random character of the lesion. The course of the disease, moreover, is not progressive. The patient may remain in the same condition for a considerable time, and even exhibit marked improvement. But it is not uncommon for several slight attacks to occur at various intervals, as other branches of the artery become occluded.

DIAGNOSIS.—The diagnosis of the acute form of labio-glosso-laryngeal paralysis calls for little remark. It must be remembered that the symptoms may deviate from the type more than in the chronic variety, as the lesion sometimes produces irregular effects. It is chiefly liable to be confounded with the impairment of movements of the palate and tongue sometimes left after double hemiplegia, from which the history suffices to distinguish it, the two attacks of hemiplegia usually occurring at different times. The rare symmetrical affection of the surface-centres for the tongue, mentioned above, is also not simultaneous on the two sides, and it is associated with at least transient hemiplegic weakness.

PROGNOSIS.—If the patient recovers from the immediate effects of the lesion, the prognosis of the paralysis of the lips, tongue, and other parts is better than in the chronic form, inasmuch as recovery of slightly damaged structures may lead to a considerable degree of restoration of power. The prognosis is also better if there is any reason to ascribe the mischief to syphilitic disease. Nevertheless, in some acute cases the paralysis remains absolute, although even in these there is not the tendency to increase which is seen in the chronic variety.

Treatment.—Any causal indication must be carefully sought for in acute labio-glosso-laryngeal paralysis, and treated, especially evidence of syphilis. In other conditions the treatment is that for the lesion which is supposed to exist. Electrical treatment of the muscles is of great importance, in order to prevent, as far as possible, secondary degenerations, which are apt to occur before the partially damaged structures have recovered. The remarks regarding diet and feeding in the chronic form are equally applicable to the acute variety.

(*C*) **Acute Myelitic Bulbar Paralysis.**—Synon.: Myelitis Bulbi.

In rare cases, symptoms of bulbar paralysis, as above described, come on in the acute (not sudden) manner characteristic of central inflammations, and depend on this process in the grey nuclei which are the seat of degeneration in the chronic form. Such cases, when the lesion is limited to this region, are too rare to make it necessary to do more than mention their occurrence. The process is analogous to spinal polio-myelitis, and the principles of its treatment are the same. It is more common for such an onset of bulbar symptoms to follow those of an ascending inflammation of the cord. They may also occur as the final stage in the mysterious disease, 'acute ascending paralysis,' in which it is probable that a toxic agent in the blood acts on certain parts of the nerve-centres and abolishes their function.

(*D*) **Pseudo-Bulbar Paralysis.**—The fact has been already mentioned that bilateral lesions of the cerebral hemispheres may cause symptoms closely resembling those produced by disease of the nuclei of the medulla. This effect is due to the fact that the muscles paralysed, being bilateral in use, are represented in both hemispheres, and can be innervated from either; hence compensation by the other side prevents paralysis from a unilateral lesion; but if disease afterwards occurs in the part effecting the compensation, paralysis results such as is caused by disease of the medulla, or rather (since there is no wasting) by degeneration of the fibres from the cortex to the bulbar nuclei, homologous with those of the pyramidal tracts. The lesions causing pseudo-bulbar paralysis may be in the cortical centres, or in the internal capsule, or in the outer parts of the lenticular nuclei, where they probably implicate the fibres from the centres in the lower part of the 'motor' region related to the lips, tongue, &c. The lesions may be of any kind, but are generally sudden and due to vascular disease. Hemiplegia usually attends the onset, and constitutes a distinguishing feature of these cases.

W. R. Gowers.

LACRYMAL APPARATUS, Diseases of (δάκρυον, a tear).

The lacrymal apparatus consists of the gland, with its excretory ducts; and of the puncta, the canaliculi, the lacrymal sac, and the nasal duct, through which superfluous tears are conveyed into the nose. The diseases of this apparatus are almost limited, with the exception of growths affecting the gland itself (*see* Orbit, Diseases of), to the excessive secretion of tears, and to impediments to their escape into the nose. To excessive secretion, or to impeded outflow, the common term *epiphora* has been applied; but the great majority of cases of epiphora are due to the latter of the two causes.

Epiphora.—*Excessive secretion of tears* is described by authors as an affection for which it is not always possible to discover an adequate cause, and it may perhaps be sometimes due to the prolonged operation of emotional influences. In most instances, however, it is associated with some kind or degree of conjunctival irritation, and is to be regarded only as a reflex phenomenon hence arising. It is well known that any temporary or accidental irritation, such as may arise from the intrusion of a foreign body into the conjunctival sac, is apt to be followed by a copious secretion of tears, which assist in dislodging the offender; and irritations of a more chronic kind, produced by congestion or irregularity of the lining membrane of the lids, may have a similar effect.

Impediments to the escape of the tears, causing them to collect in the conjunctival sac, or even to flow over the cheek, may depend upon displacement of the puncta, so that these apertures are no longer applied to the conjunctival surface, from which they normally remove superabundant moisture by capillary attraction. Such displacements affect chiefly the punctum of the lower lid; and may be consequent either upon conjunctival swelling, by which the lid is pushed away from the eye, or upon paralysis or weakness of the orbicularis muscle, which allows the lid to fall by the action of gravity. In some cases epiphora will depend upon obliteration or occlusion of the puncta. The former condition is incurable; the latter may be produced by plugs of inspissated mucus, which may be removed by the careful employment of a probe.

But the most ordinary cause of obstruction is stricture of the nasal duct; in which condition the tears are arrested a little below the sac, and the sac consequently becomes over-distended. In this condition, the sac can be seen and felt as a small lump, situated just beneath the *tendo oculi*. When pressure is made upon this lump, a fluid, consisting of tears mixed with more or less mucus or muco-pus, will regurgitate into the eye, and the lump itself will disappear. The danger in such cases is that the continued distension of the sac will in time excite inflammation of its lining membrane, leading to the formation of pus, and this to an opening upon the cheek, producing what is called a *lacrymal fistula*. Such an opening never heals until the duct is again pervious, and it is liable to undergo periodic attacks of unsightly inflammation.

Treatment.—In all cases of lacrymal hypersecretion, the first thing to be done is to search under the lids for any concealed foreign body which may be lurking there. If none be detected, examination must be made for conditions likely to be irritating; and they are to be treated, if they exist, by mild astringent or other suitable local applications. There is probably no medicine which can be said to exert any positive effect in diminishing the amount of the lacrymal secretion.

If the displacement of the lid can be cured by treatment addressed to its causes, the tears will usually return to their accustomed channel. If the displacement be incurable, as happens in some cases of paralysis of the *portio dura*, or of chronic ectropion, the patient may often be relieved by slitting open the canaliculus as far as the caruncle, so as to carry back the aperture to the secretion which it is designed to remove.

The treatment of stricture of the nasal duct can often be only palliative. The patient should acquire the habit of emptying the distended sac by finger-pressure many times a day, and of wiping away the fluid; while, to diminish the irritation of the mucous membrane, a drop of any mild astringent lotion may be applied to the inner corner of the conjunctiva two or three times a day, immediately after such pressure has been made. Perhaps the lotion most generally suitable for this purpose is a solution of acetate of lead in distilled water, of a strength not exceeding three grains to the fluid ounce.

When a radical cure is desired, the canaliculus must be slit up, and the patency of the duct restored by the passage of probes through the stricture. If fistula has already formed, or even if the sac is the seat of an abscess, no other plan is available; but for the necessary details the reader is referred to works on ophthalmic surgery.

R. Brudenell Carter.

LACTATION, Disorders of.—Synon.: Fr. *Troubles de la Lactation*; Ger. *Störungen der Milchdrüsen*.—The disorders of lactation are numerous. Sometimes the quantity of the lacteal secretion is excessively small and quite inadequate for the support of the child. At other times it is so abundant that the milk will flow from one nipple as the infant is sucking the other; and when the child is removed from the breast, the secretion continues from both sides. The term *agalactia* is applied to the former, and *galactorrhœa* to the latter condition.

1. **Agalactia.**—Agalactia signifies either a total suppression of the mammary secretion, or a very scanty supply. It results generally from anæmia and general debility.

The *treatment* should be directed towards improving the health of the patient as much as possible, by a generous and judicious diet, and tonics, particularly those containing iron. Certain drugs have been employed as galactagogues, and, it has been said, with benefit. The leaves of the castor-oil plant, boiled, have been used as a local application—the liquid for fomentation, and the leaves as a poultice; and a strong decoction of the same plant has been given as a drink. It is doubtful, however, whether such remedies are efficacious. *See* Galactagogues.

2. **Galactorrhœa.**—This occurs in two forms. In the one the composition of the milk is normal, but the quantity excessive; in the other form the increase in the bulk of the secretion is due to a preponderance of the watery part of the fluid.

Remedies employed to reduce the amount of the mammary secretion are termed *galactophyga*, and the chief of these are belladonna and iodide of potassium. Belladonna is employed as an outward application, as well as administered internally. The extract rubbed up with glycerine may be spread on lint, and thus applied to the breasts, or the emplastrum belladonnæ may be used. The child should not be put to the breast too frequently. If the excessive secretion continue for any length of time, great emaciation may result; and to this condition the term *mammary diabetes* has been applied. Under such circumstances lactation should be entirely stopped as soon as possible. Strapping the breasts tightly immediately after they have been emptied is of use. Every care must be taken to avoid the formation of a mammary abscess; and if the breasts get hard and knotty a breast pump should be employed to free the tubes.

3. **Depressed Nipples.**—Depressed nipples are generally produced by the pressure of stays. If this condition be observed during pregnancy, periodic attempts should be made to draw the nipples out by means of a glass nipple-shield, to which an india-rubber tube and teat is attached.

4. **Fissures and Excoriations of the Nipples.**—These often lead to abscess, and it is said that they may sometimes end in malignant disease. To avoid the occurrence of these lesions, astringents should be applied to the nipples during pregnancy, in order to harden them. Eau-de-Cologne and water,

brandy and water, or a weak solution of tannin, may be employed for this purpose.

Sometimes an abrasion on the surface forms an ulcer or a crack at some part of the nipple, most frequently at its base, which gives rise to great pain during suckling. The remedies for these cracks are astringent applications, such as tannin, flexible collodion, a weak solution of nitrate of silver or of carbolic acid. Care should be taken to sponge these away before the infant is again put to the breast; and a nipple-shield with an india-rubber teat will be found of great service.

For abscess and other morbid conditions of the mammary gland supervening during lactation, *see* Breast, Diseases of; Milk Fever; and Nipple, Diseases of.

Clement Godson.

LACTEAL VESSELS and GLANDS, Diseases of.—*See* Lymphatic System, Diseases of; and Mesenteric Glands, Diseases of.

LADYSMITH, in Natal.—*See* Africa, South.

LAGOPHTHALMOS (λαγός, a hare; and ὀφθαλμός, the eye).—This term is derived from an old supposition that the hare sleeps with its eyes open; and is applied to a condition in which there is inability to close one or both eyes. Lagophthalmos may be due to paralysis of the orbicularis, in which case it will be attended by falling of the lower lid, and will generally be associated with paralysis of other muscles supplied by the *portio dura* (*see* Facial Paralysis); to the contraction of cicatrices; to spasm of the upper eyelid (*see* Third Nerve, Diseases of); or possibly to congenital malformation of the lids. In paralytic lagophthalmos, the treatment is that of facial paralysis. Where there is contraction or deformity, each case must be considered on its own merits, with regard to the possibility of obtaining relief from a surgical operation.

R. Brudenell Carter.

LANGEN-SCHWALBACH, in Nassau.—Chalybeate waters. *See* Mineral Waters.

LARDACEOUS DISEASE (*lardum*, bacon).—A synonym for albuminoid disease, which is so called from the supposed resemblance of the cut surface of an affected organ to raw bacon. *See* Albuminoid Disease.

LARVALIS (*larva*, a mask).—A term usually associated with porrigo. The thick incrustation which is sometimes seen covering the face of children affected with eczema, and constituting a hideous mask to the features, is an example of *porrigo larvalis*, or rather *eczema larvale*, as likewise is ordinary milk-crust.

LARVATED (*larva*, a mask).—A term applied to certain diseases, when their ordinary characters are masked or concealed; as, for example, typhoid fever. *See* Typhoid Fever.

LARYNGEAL PHTHISIS.—A morbid condition of the larynx, of a tubercular nature, and almost invariably associated with pulmonary phthisis. *See* Larynx, Diseases of: 8. Tuberculosis; and Phthisis.

LARYNGISMUS STRIDULUS (*larynx*, the windpipe; *stridor*, a noise).—A form of obstructed breathing, attended with a peculiar stridor or crowing sound during inspiration, and dependent on spasm of the muscles of the glottis. *See* Larynx, Diseases of: 6. Spasm.

LARYNGITIS.—Inflammation of the larynx. *See* Larynx, Diseases of: 2. Inflammation.

LARYNGOSCOPE, The (λάρυγξ, the larynx; and σκοπέω, I look).—Definition.—An instrument for illuminating the interior of the larynx and trachea, and reflecting those parts so as to present their image to the eye of the observer.

Description.—The apparatus for laryngoscopy consists of a small round plane mirror, set on a metal stem and fixed in a wooden handle, for introduction into the throat; and, for concentrating and reflecting the light into the throat, a concave reflector to be worn in front of the forehead, or perforated for wearing in front of the eye of the observer. With this throat-mirror and reflector, any lamp, or even a candle, is available; but brilliant illumination contributes so much to the distinctness of the image that some apparatus to condense the light, such as a bull's-eye lens, is also desirable. The oxyhydrogen or limelight gives the best illumination, but a further development of the electric light may be expected to yield equally good results.

Application.—In practising laryngoscopy, the first object is to throw a brilliant light into the pharynx.

The patient being placed beside and a little in front of the lamp, the operator seats himself opposite him, and adjusts the reflector which he is wearing, so that when the patient sits upright, with his head inclined slightly back, his mouth widely open, and the tongue put out, the light shall be concentrated on the back of the pharynx and velum palati.

The first object being thus attained, the next is to throw the light into the larynx. While the patient breathes deeply and quietly, his protruded tongue, protected by a napkin or handkerchief to prevent its slipping, is held steadily but gently forward, either by his own hand, or by the disengaged hand of the operator; and the throat-mirror, *previously* *warmed* to prevent the condensation of moisture on its surface, supported like a pen, is passed into the patient's throat, and held with its back steadily pressing against and raising the soft palate and uvula, at such an angle that it throws the light into the larynx. This angle will vary according to the position of the patient and the part of the larynx which we wish especially to examine. The inclination of the mirror must then be altered—it must be raised or lowered, brought forward or advanced further in the pharynx, as may be necessary. The operator must observe which part is reflected in the mirror; and in moving it, he is guided by his knowledge of the relations of the various parts of the larynx to each other. Unless the tonsils are enlarged, no part of the fauces or pharynx, except the soft palate and uvula, should be touched; and the observer must be specially careful that the lower edge of the mirror does not come in contact with the back of the pharynx. He must remember also that, while steady pressure can be borne, titillation of any part of the fauces will induce retching. Where the throat is very irritable, a 20 per cent. solution of the hydrochlorate of cocaine brushed over the soft palate and pharynx will greatly facilitate laryngoscopic examination. Enlarged tonsils may present an insuperable obstacle to successful examination; in slighter cases either a very large round mirror which presses the tonsils on one side, or a small ovate mirror, should then be used. More frequently a pendulous epiglottis hanging back over the upper part of the larynx impedes the view; in such a case the patient must utter, or try to utter, in a high falsetto tone, a prolonged 'eh,' or he must force a laugh or a cough, and the mirror must be held lower in the pharynx, in a more vertical position.

For the topical treatment of laryngeal diseases, in addition to the laryngoscope, the practitioner requires a laryngeal probe or sound; brushes or cotton-wool holders on stout metal handles, curved at a suitable angle for applying solutions; an insufflator for the introduction of powders; and a scarifying instrument. For the operative treatment of polypus, &c., a set of special forceps, a laryngeal écraseur, special knives, and other instruments are necessary; while, for use by the patient, a spray-producer or atomiser, and a simple inhaler, will be required. THOMAS JAMES WALKER.

LARYNX, Diseases of.—The functions and peculiar anatomical position of the larynx give to its diseases a special importance; and in addition to such objective and subjective symptoms as are common to affections of other organs, we find here modifications of respiration, vocalisation, and deglutition.

The principal diseases and disorders which affect the larynx may be conveniently enumerated and described in the following order: (1) Disorders of Circulation; (2) Inflammation; (3) Leprosy; (4) Lupus; (5) Nervous Affections; (6) Spasm; (7) Syphilis; (8) Tuberculosis; and (9) Tumours. *See* also CROUP; DIPHTHERIA; and TRACHEA, Diseases of.

1. Larynx, Disorders of Circulation of.—*Anæmia* of the larynx does not exist as a separate disease. Like pallor of the gums, it is described as one of the symptoms of incipient phthisis.

Congestion of the larynx requires a passing notice. Hyperæmia of some portion of the mucous lining of the larynx results from over-exertion of the voice, exposure to cold, the action of irritants, or any cause obstructing the circulation through the larynx; and it may be consecutive to laryngitis. It causes more or less persistent hoarseness, and a sense of discomfort in the throat; and it excites what is commonly called a 'tickling cough.' Congestion is clinically inseparable from laryngitis.

TREATMENT.—Treatment of congestion of the larynx is unnecessary, beyond resting the voice, if the congestion is merely temporary. If more persistent, astringents should be applied locally, as in cases of chronic laryngitis.

2. Larynx, Inflammation of.—The varieties of laryngitis treated of here will be considered under the following headings: (*a*) **Acute** — including i. *Catarrhal*; ii. *Phlegmonous*. (*b*) **Chronic.**

(*a*) **i. Acute Catarrhal Laryngitis.**—SYNON.: *Laryngitis Catarrhalis*; *Cynanche Laryngea*; Fr. *Laryngite Aiguë Catarrhale*; Ger. *Kehlkopfentzündung*.

DEFINITION.—Acute catarrhal inflammation of the mucous membrane of the larynx.

ÆTIOLOGY.—Laryngitis is more common among males than females, and among children than adults. The most frequent exciting cause is exposure to cold, but the disease may often be attributed to sudden changes of temperature, a damp or irritating atmosphere, the inhalation of acid vapours or gases, excessive use of the voice, and to the abuse of alcohol, hot drinks, and spices. It may be due to accidental attempts at swallowing boiling water. The catarrhal process may be propagated from the pharynx or nose. It occurs also as a complication of exanthematous fevers—especially of measles. Sedentary occupations, and anything that depresses the vitality of the body, may predispose to laryngitis.

ANATOMICAL CHARACTERS.—Acute laryngitis is characterised by the changes common to catarrhal inflammation of other mucous membranes: hyperæmia, swelling, and increased secretion. Small superficial erosions may occasionally occur, especially at the posterior extremities of the vocal cords, but ulceration does not extend below the epithelial layer.

SYMPTOMS.—A mild attack of laryngitis

commences with hoarseness, irritable cough, a sense of tickling and soreness about the larynx, without any febrile disturbance. Subsequently the voice may be completely lost. In severe cases the patient becomes restless and anxious; experiences a feeling of constriction about the rima; complains of sore-throat in swallowing; and points to the larynx as the seat of pain. The breathing is altered, having more or less the characteristics of laryngeal obstruction, namely, the long-drawn hissing inspiration, prolonged expiration of the same character, but with less of the sibilant sound, and diminution or complete abolition of any pause between successive respiratory efforts. The voice also is altered, becoming husky and uncertain, deeper in tone, and croaking in quality. The patient likewise suffers from cough, of the same character as the voice; from the imperfect closure of the vocal cords it wants sharpness, is husky, and sometimes is accompanied by a hollow, clanging sound, constituting what is commonly called the *croupy cough.* The expectoration varies according as the inflammation involves the larynx alone, or extends to the trachea and bronchi. In the former case it is usually clear, thin, tenacious mucus, which is *hawked* rather than coughed up, mixed with the saliva, which is freely secreted but not swallowed. Sometimes the expectoration contains harder pellets, secreted in the ventricles of the larynx; whilst, if the trachea and bronchi are involved, the usual thick expectoration of bronchitis is also coughed up. Deglutition is painful and difficult owing to implication of the aryepiglottic folds and epiglottis; yet the pharynx, on inspection, shows only a little redness, quite inadequate to account for the dysphagia. Accompanying these symptoms there is a rapid pulse, and slight rise of temperature, though the tongue may be moist, and other indications of inflammatory fever slight.

The laryngoscope reveals congestion of the larynx, which varies much in extent and degree. In slight cases the reddening may be confined to special parts, like the epiglottis and vocal cords, without any appreciable swelling of the affected structures. The cords usually exhibit changes, which account sufficiently for the hoarseness. During attempts at phonation they are often seen to be imperfectly approximated, being separated by an elliptical fissure, the result of paresis of their internal tensor muscles, the thyro-arytenoidei interni. Less frequently the posterior part of the glottis remains open during phonation, forming a triangular space with the apex directed forwards, a condition depending on paresis of the arytenoideus muscle. These pareses of the cords are probably due to inflammatory implication of their neuro-muscular apparatus. Protrusion of the swollen inter-arytenoid fold between the posterior ends of the cords, preventing their due adduction, is an occasional source of hoarseness. At other times no definite loss of movement can be recognised, and here the hoarseness is to be ascribed to alterations in the tension and vibration of the cords produced by the catarrh. In the severe type the whole larynx is congested, and the aryepiglottic folds, epiglottis, and ventricular bands are swollen so as to hide the vocal cords more or less.

In most instances of the mild form, recovery ensues in a few days.

If the case progress untowardly, the restlessness and anxiety increase; suffocative paroxysms occur and recur with increasing frequency; the patient's whole attention appears concentrated on the effort of breathing; he dreads to speak or swallow, and if obliged to say anything, he takes first a laboured inspiration, and then, with a straining effort, brings out what little voice is left. Gradually, as the aëration of the blood becomes more imperfect, drowsiness comes on; the eyes, staring in the previous stage, are half closed by the drooping lids; the face, bathed in perspiration, becomes livid; and death occurs, probably in a paroxysm of suffocative dyspnœa.

Acute laryngitis occurring in young children, sometimes termed *spasmodic laryngitis* or *false croup*, differs somewhat from the description just given. These differences depend on the small size of the child's larynx, and on the tendency to spasm incidental to this age. Without any previous illness beyond, possibly, a slight cough and hoarseness, the child is suddenly seized at night with a barking cough, noisy stridulous inspiration, and more or less urgent dyspnœa. The suffocative seizure seldom lasts more than a few minutes; but it may recur the same night, or on successive nights, the child being generally free from all symptoms, except slight cough and hoarseness, during the daytime. These attacks are mainly due to spasm of the sphincter muscles of the larynx; but in all probability they are also partly the result of drying of the secretions accumulated during sleep, and consequent narrowing of the glottis. Paroxysmal dyspnœa of the same nature, and due to the same cause, may develop as a complication of the exanthemata, especially measles.

Diagnosis.—Acute laryngitis is apt to be confounded with that form of inflammation which is characterised by the formation of a false membrane in the larynx, namely, croup or laryngeal diphtheria. If practicable, a laryngoscopic examination, showing the absence of false membrane, is the most certain means of diagnosing simple from pseudo-membranous laryngitis; but even where perfect casts of the trachea, bronchi, and primary bronchia are expectorated, the larynx may be absolutely free from false membrane, and simply inflamed. The absence of diphtheritic membrane in the fauces, of acrid excoriating discharge from the nostrils, and of glandular swellings, as well as the mode of accession of the symptoms, would lead us to regard the case as simple laryngitis; while the presence of any of these symptoms, or the prevalence of an epidemic of diphtheria, would lead us to suspect false membrane. Even after due consideration of these points, and of the character of the voice, cough, &c., in certain cases, we are unable to say whether we have to deal with simple or with pseudo-membranous laryngitis. The acute laryngitis or false croup of children is further distinguished from true croup by the sudden accession of the symptoms at night, and by the progress of the case—true croup or diphtheria increasing in intensity, while, from the first sudden onset of the symptoms, false croup diminishes, unless complicated with lobular pneumonia or other severe disease. From laryngismus stridulus, acute laryngitis is distinguished by the presence of slight pyrexia and other indications of primary inflammatory affection of the larynx and air-passages ; by the absence of indications of any other affection of the nervous system, or of a tendency to convulsions ; by the usual occurrence of the attack in the night only ; by the slighter affection of the breathing ; and by the frequent *croupy cough*, which is the prominent symptom, and which is wanting in laryngismus.

Prognosis.—In mild attacks of laryngitis all the symptoms exist only in a slight degree, and disappear in a few days under simple treatment. Such is the ordinary course of the false croup of children. In adults laryngitis may occur in any degree between the mildest form and that in which, the symptoms being all most intense, it may prove fatal in a day or two, or even in a few hours. The danger depends in great measure on the amount of swelling present. Although mild laryngitis usually terminates favourably in a few days, it is necessary that every case should be sedulously watched, as at any period dangerous symptoms may set in and prove rapidly fatal. The disease is most deadly in the young. Acute may pass on to chronic laryngitis.

Treatment.—As soon as the first indications of even slight laryngitis are observed, the patient should be confined to a warm room, at a temperature of 65° F., a kettle being kept boiling to moisten the atmosphere. Talking must be forbidden, in order to ensure as much rest to the larynx as possible. The diet should be chiefly liquid, and no stimulants are required. As a rule, no further treatment is necessary ; but, if the cough be troublesome, we may prescribe a saline diaphoretic draught, with small doses of morphine, and 4 or 5 minims of antimonial wine every three or four hours. The cough and sense of dryness, or soreness of the throat, are generally relieved by the inhalation of simple steam, or by the vapour of compound tincture of benzoin, one drachm being added to a pint of hot water. In every case a regular evacuation of the bowels is to be secured. If swelling of the larynx ensue, the patient must be directed to suck ice constantly. Should the dyspnœa become urgent, tracheotomy must be performed at once. With due care in the performance of the operation and after-treatment of the patient, in cases of simple laryngitis, tracheotomy is almost always successful, but it should not be resorted to unless the case is urgent.

Simple cases of false croup in children are usually relieved by warm poultices to the throat. An emetic may be administered in the comparatively rare instances in which dyspnœa depends on insufficient removal of secretions from the larynx.

A brief allusion may here be made to the method of intubation which has been successfully practised by Dr. O'Dwyer and others for the relief of laryngeal diphtheria. It is possible that further experience may warrant the adoption of this treatment in place of tracheotomy, in certain cases of laryngitis associated with stenosis, whether in the child or adult.

ii. **Phlegmonous Laryngitis.**—Synon.: *Œdema Glottidis* ; Œdema of the Larynx ; Œdematous Laryngitis; Fr. *Laryngite Œdémateuse* ; Ger. *Kehlkopfoedem.*

Definition.—Inflammatory exudation into the submucous tissue of the larynx of serous, sero-purulent, or sero-fibrinous fluid.

Ætiology.—Phlegmonous laryngitis occasionally arises as a primary disease, and is then to be regarded as a symptom of septic infection; thus in rare instances it seems to have been the earliest manifestation of erysipelas.

Mechanical injuries, and the direct action of boiling water, corrosive poisons, and foreign bodies are less uncommon causes. Phlegmonous laryngitis may also develop in the course of specific fevers, such as measles, scarlatina, small-pox, typhoid fever, diphtheria, pyæmia, and in renal disease.

In most cases, however, the laryngeal affection is the result of extension of disease from neighbouring parts, pharyngitis, whether dependent on erysipelas or other causes, being the most common antecedent.

Inflammatory affections of the cervical connective tissue, and perichondritis, or deep ulceration of the larynx, associated with carcinoma, syphilis, or tuberculosis, are also occasional causes of phlegmonous laryngitis.

Anatomical Characters.—The mucous surface presents a dull red or livid colour, and is greatly swollen, owing to infiltration of the submucosa. A certain amount of pus is generally diffused through the exudation, but it is rare for a circumscribed abscess to form. The process usually attacks first the aryepiglottic folds and the epiglottis, and it may extend thence to the ventricles and other parts of the larynx, the vocal cords themselves being seldom affected. The submucous tissue below the vocal cords, lining the cricoid cartilage, may very occasionally be the sole seat of the disease.

Symptoms.—The symptoms indicative of the severe laryngitis exist in an increased degree in this affection, the swelling of the epiglottis interfering especially with deglutition, and that of the aryepiglottic and ventricular bands causing very dangerous dyspnœa. By examination with the finger and, far better, by the laryngoscope, we observe further the physical condition caused by the swelling. The epiglottis is congested, misshapen, rounded like a chestnut, or its two sides swollen so as to resemble two mucous bladders pressed together in the middle line; and, unless this hides the rest of the larynx, the aryepiglottic folds will be recognised as two long rounded swellings, passing from before back, and nearly meeting in the centre, the ventricular bands being visible only when there is little swelling above. The prognosis in such cases is extremely grave.

Treatment.—The patient should suck small pieces of ice, leeches might be applied over the larynx, and an attempt may be made to reduce the swelling by scarification with a curved laryngeal bistoury, but in most instances tracheotomy is required.

(*b*) **Chronic Laryngitis.**—Definition. Chronic inflammation of the mucous membrane of the larynx.

Ætiology.—Chronic laryngitis is often, but not invariably, a sequel of acute laryngitis, and is due to the same causes. Chronic affections of the nose and pharynx frequently co-exist, and seem in some instances to be the starting-point of the malady.

Anatomical Characters.—The mucous membrane of the larynx is hyperæmic, and may be slightly swollen, the vessels being often dilated in patches. The morbid process may extend in rare cases to the submucosa, producing diffuse connective-tissue thickening, or small warty growths, especially on the vocal cords—'chorditis tuberosa' of Türck. Marked enlargement of the veins on the epiglottis is occasionally observed, and is probably the result of the chronic catarrh.

Symptoms.—The symptoms of chronic laryngitis are hoarseness or aphonia after slight exertion of the voice; a hacking cough, with but little of the brassy, laryngeal character; either no expectoration, or only a little tenacious mucus; and a sense of dryness and tickling, with slight pain, in the throat.

The laryngoscope shows a varying amount of congestion, either general or local, but the hyperæmia is seldom so pronounced as in acute laryngitis. The cords are usually affected, presenting a pinkish, slightly thickened appearance.

Mucous secretion is often seen sticking to the inter-arytenoid fold or to the anterior angle of the glottis. In a special variety of the disease, known as 'laryngitis sicca,' the secretion is apt to dry and form adherent scales or crusts, in consequence of some modification of its composition. Epithelial erosions are not uncommon, but ulceration never occurs. Pareses of the vocal cords often ensue, giving rise to changes in the glottis, as described under Acute Laryngitis.

In the rare instances in which thickening invades the subglottic region, stenosis commonly ensues, and obstructive dyspnœa becomes a prominent symptom.

Diagnosis.—In cases of chronic disease of the larynx a laryngoscopic examination is indispensable. Without the laryngoscope diagnosis and treatment can be only guesswork; with it, the appearances described above are clearly recognised. Where chronic laryngitis is persistent, the possibility of tuberculosis must be kept in mind, and repeated examination of the lungs and sputum should be made. In elderly or middle-aged patients a localised swelling and congestion of the vocal cords, especially if associated with impaired mobility, should arouse the suspicion of carcinoma.

Prognosis.—Chronic catarrhal laryngitis may subside spontaneously, but is usually persistent unless properly treated.

Treatment.—Any imprudence in diet or hygiene must be corrected, pungent condiments or spices, very hot drinks, alcohol in excess, smoky or dusty rooms, being avoided, and the voice rested as much as possible. About every other day the larynx should be brushed out with an astringent lotion. In mild cases a solution of chloride of zinc, 30 grains to the ounce, will suffice; but if this fail, a more powerful astringent, nitrate of silver 10 to 40 grains to the ounce, should be employed. Such applications should not be continued for more than two or three weeks at a time.

Inhalations of chloride of ammonium, pine oil, and creasote are recommended by some physicians. In some obstinate cases the waters of Ems, Reichenhall, Marienbad, Aix-les-Bains, and other spas are believed to yield good results. Attention must be paid to the general health, and to the state of the digestive organs.

3. **Larynx, Leprosy of.**—Ætiology.—The causes are identical with those of leprosy in other situations. Leprosy of the larynx may be associated with a similar affection of the buccal mucous membrane, the tongue, and the palate.

Anatomical Characters.—The lesions at first consist of a nodular thickening of the epiglottis and aryepiglottic folds, which may be succeeded by very chronic ulceration and cicatrisation. Ultimately the disease may invade other parts, and cause stenosis of the larynx.

Symptoms, Complications, and Diagnosis. The symptoms of laryngeal leprosy are those of chronic inflammation; and, if the nodules ulcerate, the ulceration is very slow, and not of the destructive character of syphilis. As leprosy of the larynx occurs only when the disease of the skin has been long established, its diagnosis is clear. It usually exists for a long time, even years, before it ulcerates; and even after this it is very slow in its progress, and not fatal.

Treatment.—As in other forms of leprosy, treatment is almost useless. Tracheotomy must be performed if stenosis occur. *See* Leprosy.

4. **Larynx, Lupus of.**—Ætiology.—The causes of this disease and of lupus of the skin are identical. It is doubtful whether the larynx is ever primarily affected.

Anatomical Characters.—Small nodules appear on the epiglottis, and subsequently on the aryepiglottic folds and other parts of the larynx, associated sooner or later with thickening and ulceration of the mucous membrane. Cicatrisation of the ulcers is almost an invariable feature of such cases.

Symptoms, Complications, and Diagnosis. Lupus of the larynx may give no definite symptoms, even when pronounced lesions exist, and doubtless on this account this affection of the larynx is often overlooked. In other cases the symptoms are those of chronic inflammation; but there appears to be less tendency to œdema or to those affections of the cartilages which occur in syphilis and tuberculosis. Lupus is distinguished from syphilis by its prevailing nodular character, and by the slow progress of ulceration. From tuberculosis, which it more closely resembles, it differs mainly in its marked tendency to the formation of cicatrices. But in all cases the diagnosis turns principally on the presence of lupus of the skin. It lasts for many years.

Treatment.—Lupus of the larynx must be treated constitutionally in the same way as other forms of lupus, and locally by caustics or the galvanic cautery. Lactic acid, applied as in cases of laryngeal tuberculosis, promises to be of service in lupus also. *See* Lupus.

5. **Larynx, Nervous Affections of.**—(1) Sensory Disorders of the Larynx.—*Hyperæsthesia* of the laryngeal mucous membrane is a usual accompaniment of inflammation, acute and chronic, and is a not infrequent symptom of hysteria, hypochondriasis, and neurasthenia. *Anæsthesia* occurs in cases where the superior laryngeal nerve or its centres are affected, and especially as a sequel of diphtheria. It is also an occasional symptom of bulbar paralysis and hysteria, and is said to accompany epileptic fits. *Hemianæsthesia* may result from tumours of the base of the skull. *Paræsthesia*, in which the larynx is the seat of various perverted and unaccountable sensations, is not an uncommon manifestation in anæmic, hysterical, and hypochondriacal patients.

(2) Motor Disorders of the Larynx.—(*a*) *Spasm* is considered in a separate section. *See* 6. Larynx, Spasm of.

(*b*) *Paralysis* of the larynx is of great variety. It will be best discussed, first, under the head of the *nerves* affected; and, secondly, with respect to the individual *muscles* paralysed.

i. *Paralysis of the Superior Laryngeal Nerve.*—In this rare condition, depending either on diphtheria or bulbar paralysis, the interior of the larynx is quite insensitive to the introduction of a probe; the epiglottis lies motionless against the base of the tongue, owing to paralysis of its depressors—the thyro-epiglottic and aryepiglottic muscles; and the voice is said to be rough and low-pitched, from palsy of the cricothyroid muscles. The glottis is represented by a wavy line, in consequence of paralysis of the external tensors. The immobility of the epiglottis and the anæsthesia are a source of great danger, as food is likely to enter the larynx and lead to pulmonary complications. Food must be administered by the œsophageal tube in such cases. *See* Labio-Glosso-Laryngeal Paralysis.

Paralysis of the Recurrent Laryngeal Nerve.—Complete paralysis is generally due to pressure of an aneurysm of the aorta or other intrathoracic tumour, or of a goître, on the nerve after its origin from the vagus, but the same effect may follow degenerative or destructive lesions of the motor fibres, in any part of their course from the medulla oblongata down to their peripheral termination. Bilateral paralysis, in the very rare instances in which it has been observed, was the result of carcinoma of the œsophagus, double aneurysm of the aorta and innominate artery, tumours of the base of the brain, extensive pericardial effusion, and, lastly, pressure on the trunk of one pneumogastric nerve, for example, by enlarged bronchial glands. Bilateral paralysis, following unilateral pressure, is regarded by Sir George Johnson, who first observed it, as an instance of reflex paralysis; but the more general belief is that secondary changes are set up in the nuclei of the recurrent laryngeal nerves, as the result of ascending irritation. The symptoms of bilateral paralysis are aphonia, inability to cough, and slight stridor. Slight dyspnœa may be induced by attempts to speak. The vocal cords are seen lying motionless and relaxed, in a position midway between abduction and adduction. In unilateral paralysis, which is the usual form and is more common on the left side, one cord alone occupies the position just described, but, as the healthy cord crosses over the middle line during phonation to meet its palsied fellow, there is no aphonia, though the voice is generally weak and uncertain.

Hitherto complete paralysis alone has been considered; but paralysis depending on structural disease of the fibres or nuclei of the recurrent laryngeal nerves is far more often incomplete. In these circumstances, as Dr. Semon and Dr. Rosenbach have shown independently, the fibres supplying the abductor muscles are the first to suffer. In course of time the adductors may become affected also, but paralysis of these muscles is seldom complete. This fact is attributed to a greater vulnerability of the abductor nerve-fibres than of those supplying their antagonists, the adductors. Dr. Semon believes that the abductor muscles themselves are less resistant than the adductors. It is impossible to discuss here the experiments and clinical facts on which this important doctrine is based.

ii. *Paralysis of Individual Muscles.—Bilateral Abductor Paralysis.*—The cause may be either central—as in tabes dorsalis, bulbar paralysis, syphilitic or other intracranial disease; or peripheral—lesions of both recurrent or pneumogastric nerves, pressure on the trunk of one vagus, or degenerative affections of the abductor muscles, as described under the preceding heading. The symptoms are severe inspiratory dyspnœa and stridor, and weakness or slight hoarseness of the voice. With the laryngoscope the cords are found lying close together, being separated by a mere chink. On phonation they approximate as usual, but during deep inspiration no divergence takes place, and a slight movement of adduction is generally observed. This action is attributed either to the effects of suction, or to a perverted innervation of the unopposed adductors. Bilateral paralysis may cause fatal suffocative attacks, and, if persistent, necessitates the performance of tracheotomy.

Abductor paralysis may be simulated by mechanical fixation from ankylosis or arthritis of the crico-arytenoid joints, or by cicatricial or inflammatory changes in their neighbourhood. Diagnosis is often difficult in such cases, but in the latter condition there is usually some distortion of parts, such as contraction, irregularity, or swelling about the arytenoid cartilages, which is not the case in paralysis.

Unilateral Abductor Paralysis. — This condition is generally attributable to peripheral causes, and especially to compression of the left recurrent or vagus nerve within the thorax by an aneurysm or other tumour, as we have just seen in discussing paralysis of the recurrent laryngeal nerve. Palsy of the right abductor is an occasional result of chronic disease of the apex of the right lung. The affected vocal cord occupies the median position; but if the adductor becomes involved, the cord recedes from the middle line and takes up a situation between that of abduction and adduction. The symptoms of unilateral paralysis are slight hoarseness and dysphonia, but dyspnœa and stridor do not occur except on exertion.

Paralysis of the Adductors.—Paralysis of these muscles is nearly always bilateral, and is probably the result of a central nervous affection of a functional nature, occurring in hysterical, neurotic, or anæmic subjects. It is doubtful whether gross nervous disease ever leads to isolated paralysis of the adductors. The patient, generally a female, becomes suddenly aphonic, but the reflex acts of sneezing and cough are still attended with the usual sound. Attempts to speak occasion a slight degree of dyspnœa, due to the escape of breath through the widely open glottis. The laryngoscope shows that the cords are abducted normally, but do not approach one another during efforts to phonate.

Paralysis of the Internal Tensors.—The internal tensors or thyro-arytenoidei interni may be paralysed, on one or both sides, as a consequence of laryngitis or of hysteria. According as the affection is bilateral or unilateral, there is aphonia or mere hoarseness.

During phonation the vocal cords are separated by an oval or elliptical space, and appear to be very thin and narrow, owing in all probability to deficient tension.

Paralysis of the External Tensors, the crico-thyroids, is unknown, apart from the results of paralysis of the superior laryngeal nerve.

Paralysis of the Arytenoideus.—This is also commonly a result of hysteria or of laryngeal catarrh, and gives rise to hoarseness or aphonia. During phonation the cords meet in front, but are separated posteriorly by a triangular gap.

TREATMENT. — If the paralysed condition depend on serious disease outside the larynx, local treatment is of little avail. When syphilis or aneurysm is suspected, iodide of potassium should be prescribed freely. In cases of adductor paralysis, anæmia and the hysterical state must be suitably treated, and intra- or extra-laryngeal faradisation may be tried, but sudden recovery often occurs without any treatment. *See* PNEUMOGASTRIC NERVE, Diseases of.

6. **Larynx, Spasm of.**—In the description of other diseases of the larynx, this condition has been referred to as a frequent complication. Spasm causes the urgent symptoms when the larynx is irritated by the lodgment of a foreign body or the like. It may result from pressure on, or disease of, the pneumogastric or recurrent laryngeal nerve; from hysteria; or as a manifestation of a more general affection of the nervous system, in

which case it constitutes the following special malady.

Laryngismus Stridulus.—SYNON.: Child-Crowing; Spasmodic Croup; False Croup; Fr. *Spasme de la Glotte*; *Pseudo-croup Nerveux*; Ger. *Kehlkopfkrampf.*

DEFINITION.—Laryngismus stridulus is characterised by short or more prolonged accessions of suffocation; depending on tonic spasm of the adductor muscles of the larynx, and usually of the diaphragm and other respiratory muscles, causing closure of the glottis and a sudden arrest of inspiration; and ending in a shrill crowing sound, as the inspiratory act is resumed and concluded. It is purely a nervous disease; is unaccompanied by any inflammatory affection of the larynx or air-passages; and is often associated with other convulsive affections.

ÆTIOLOGY.—Anything causing excessive reflex irritability, rickets, chronic hydrocephalus and other organic affections of the brain or medulla oblongata, predispose to this convulsive affection. It is sometimes associated with the irritation of teething. A sudden fright, irritation of the larynx by the accidental entrance of food, or some such slight agitation as that caused by a child being tossed in the air, may excite the attack.

SYMPTOMS.—With or without premonitory indications of a tendency to convulsive affection, such as drawing-in of the thumbs and great toes, or clenching of the hands; often during sleep, and with no evident exciting cause, or at any time in the day; a child is suddenly attacked with difficult breathing, inspiration being accompanied by the crowing sound characteristic of laryngeal spasm. This may continue for some time, and then gradually subside. The spasm may be short, or it may be longer and more intense, inspiration being proportionately difficult. It may be complete, and the act of inspiration cease entirely, until, just as death seems imminent, the spasm relaxes, and with a crowing inspiration breathing is re-established. In the worst cases, and sometimes in the first attack, death does actually occur.

DIAGNOSIS.—The diagnosis of this disease from laryngitis is considered under Acute Laryngitis. The symptoms caused by a foreign body lodged in the larynx closely simulate laryngismus stridulus. The nature of the case is decided by its history; and, unless the age of the patient precludes it, by a laryngoscopic examination.

PROGNOSIS.—The milder forms of laryngismus stridulus yield to suitable treatment, and disappear as improvement takes place in the condition inducing the attack. Severer forms, if not fatal in a first, may be so in a subsequent attack. When the spasm depends on some incurable organic change in the nervous system, the case is of course hopeless from the first.

TREATMENT.—Attention to the diet and general management of the child, regular bathing, and the administration of remedies suitable to correct faults of digestion, are necessary (*see* RICKETS). The persevering use of bromide of potassium has been found beneficial by the writer (T.J.W.); and chloral hydrate is of undoubted value. For the immediate treatment of the spasmodic attack, prompt immersion in a warm bath, the administration of an emetic, or the use of an anæsthetic vapour or amyl nitrite may be resorted to; and should breathing not be re-established as the spasm ceases, dashing cold water on the face and chest, friction, application of strong ammonia or vinegar to the nostrils, and especially artificial respiration, must be adopted, with the object of restoring the respiratory function. Tracheotomy may be requisite, but the practitioner is, unfortunately, seldom present when the indications for the operation arise.

7. **Larynx, Syphilis of.**—Syphilis affects the larynx differently according to the stage of the disease at which the organ is attacked. Erythematous maculæ, raised mucous patches or condylomata, and superficial ulceration, like that seen in the fauces and pharynx, are described as secondary lesions, but are seldom actually observed, as opportunities for making a laryngoscopic examination are not often afforded. Mucous patches, represented by small greyish flat elevations, and congestion, are the commonest manifestations at this period of the disease. These patches generally disappear without leaving any trace of their existence.

The larynx is more seriously affected in advanced stages of syphilis. The lesions, consisting of diffuse infiltration, nodular gummatous deposits, or ulceration, are especially prone to attack the epiglottis and vocal cords, and in a less degree the ventricular bands and posterior wall.

The special proclivity of the epiglottis to syphilitic disease has been attributed to direct infection from the pharynx, it being an undoubted fact that syphilis generally involves the pharynx together with the larynx. Syphilitic ulceration may be superficial or deep. Deep ulcers, which are often of gummatous origin, are sharply cut, and extend rapidly. As a result, extensive destruction of the epiglottis, suppurative perichondritis, and necrosis of the various cartilages, often ensue. External fistulæ are occasionally thus produced. Perichondritis at times develops without previous ulceration. Cicatrices are almost an invariable sequel of deep ulceration, and are a great source of danger, owing to the contraction and stenosis which they occasion. Curious puckering of different parts is commonly produced, at times associated with small polypoid excrescences of the mucous membrane. These last, unlike gummata, show no tendency to ulcerate, and may gradually disappear. Adhesion and webbing of the cords, adhesion of the epiglottis to the walls of the pharynx, fixation of the vocal cords in various positions, sometimes simulating bilateral abductor palsy, and depending then on fibrous changes around the crico-arytenoid articulations,—these are some of the many effects of syphilitic cicatrisation.

In *hereditary* syphilis, lesions of the larynx generally occur within the first few months after birth, but occasionally the larynx is not attacked before the age of puberty is reached. The early manifestations of the disease in hereditary cases are represented by congestion and mucous patches ; at a later period they are not to be distinguished from those which occur in the advanced stage of acquired syphilis. Deep ulceration in any case may be associated with extensive œdematous swelling, and hæmorrhage from perforation of large vessels is an occasional occurrence.

Symptoms.—Secondary syphilitic affections cause hoarseness and sometimes loss of voice, but there is usually neither pain, cough, fever, nor dyspnœa. The more serious tertiary affections may give rise to all the symptoms caused by tubercular ulceration, but pain and dysphagia are rarely experienced except when the epiglottis is extensively ulcerated, and even then these symptoms are less severe than in tubercular cases, and the constitutional symptoms are those of syphilis, as distinguished from consumption.

Diagnosis.—Secondary syphilitic affections of the larynx are easily recognised with the laryngoscope, and there are usually other indications of the constitutional taint. The diagnosis of the disease, in its later stages, must be based on the appearance of the lesions above mentioned, combined with manifestations of syphilis in other parts of the body, especially of the skin and pharynx. In the absence of constitutional symptoms, the diagnosis may present great difficulties, especially as regards tuberculosis. This question will be discussed in the next section.

It is sometimes not altogether easy to distinguish syphilitic from carcinomatous ulceration, but in the latter disease the appearance of a growth is more pronounced, ulceration is less rapid, and pain is more often present. Moreover, the vocal cords and ventricular bands are the favourite seats of malignant growths, the epiglottis and other parts being seldom primarily affected.

The good results following the use of iodide of potassium will often assist in arriving at a correct diagnosis, but this test is open to a fallacy, as carcinoma and syphilis may coexist.

Prognosis.—The prognosis in cases of laryngeal syphilis must vary according to its form. In early cases, and where ulceration is superficial, the prognosis is very favourable, but in advanced stages the prospects of the patient are more uncertain, for, although the progress of ulceration can almost invariably be arrested by treatment, subsequent cicatrisation may cause dangerous stenosis. A knowledge of the complications incidental to deep ulceration should induce us always to give a guarded opinion.

Treatment.—Local treatment is not necessary for the secondary syphilitic affections of the larynx, and we must trust to mercurial inunction and other constitutional remedies. Syphilitic ulceration of the larynx requires persevering treatment with large doses of iodide of potassium ; and where it does not yield to this remedy, appropriately combined with quinine, cod-liver oil, &c., mercury must be employed, the best method being by mercurial inunction or the hypodermic injection of the bichloride. A combination of mercury and iodide of potassium is often useful. The local application of a solution consisting of iodine 10 grs., iodide of potassium 100 grs., glycerine 1 oz., is sometimes of service in the case of syphilitic ulcer, in addition to the above treatment. When the dyspnœa is dangerous, tracheotomy must not be delayed. It will usually prove successful, although the destruction of tissue and cicatrisation may be such as to necessitate the permanent wearing of the tube. Operations for the division of cicatricial bands and adhesions seldom give satisfactory results, owing to the tendency of the parts to unite again. Systematic dilatation, by means of Schrötter's hollow vulcanite bougies, may be tried in such cases.

8. **Larynx, Tuberculosis of.**—Synon.: Laryngeal Phthisis; Fr. *Phthisie Laryngée*; Ger. *Kehlkopftuberculose.*

Ætiology. — Laryngeal tuberculosis is almost invariably secondary to pulmonary phthisis, but in a few instances a necropsy has demonstrated the existence of tuberculous disease in the larynx without any affection of the lung. In the former case the larynx is either directly inoculated with infective sputum derived from the lung, which is the usual method, or the tubercular virus is conveyed to the larynx by the blood. Where the larynx is primarily affected, we may suppose that the infective agent, the tubercle bacillus, is inhaled, and effects a lodgment here without reaching the lung.

Anatomical Characters.—In the larynx, as in other mucous membranes, the tuberculous process may be considered under two heads—infiltration or deposit, and ulceration ; but inasmuch as the necrotic element predominates over the fibrous or indurative, the tendency is ultimately towards ulceration. The degree of infiltration varies greatly, now giving rise to massive swelling of parts like the epiglottis and aryepiglottic folds, where the submucous tissue is loosely arranged, at other times merely extending to the subepithelial layer. In the latter case, owing to the early development of ulceration, a stage of infiltration cannot generally be seen to precede loss of substance, though from analogy there is reason to believe that this is invariably the case. Definite tuberculous tumours are occasionally met with.

The parts most prone to tuberculous disease may be thus enumerated, in the order of frequency: the vocal cords and inter-arytenoid fold in about equal proportions, the aryepiglottic folds, epiglottis, and, lastly, the ventricular bands. Extension of the infiltration and ulceration to the deeper parts may lead to suppurative or adhesive perichondritis, especially of the arytenoid cartilages. Suppurative perichondritis causes necrosis, and at times extrusion of the cartilage. Œdema is a frequent complication of extensive tubercular lesions. It is unnecessary in the present article to describe the manifold changes that may be produced in different cases.

Symptoms.—The symptoms of this affection are those of an aggravated laryngitis: hoarseness or aphonia, irritable cough, difficulty or pain in swallowing when the epiglottis or aryepiglottic folds are involved, and inspiratory dyspnœa and stridor if stenosis be present. Pain shooting to the ear is occasionally complained of, and is probably referred from the sensory nerve of the larynx, the superior laryngeal, to the auricular branch of the vagus. The constitutional and local symptoms of pulmonary phthisis, which are present in varying degrees, add much to the patient's distress. In early cases the laryngoscope reveals small shallow ulcers or pale granulations on the vocal cords, particularly their posterior ends, fleshy swelling of one or both cords, and prominence of the inter-arytenoid fold, often with an irregular papillary margin. Swelling of one or both sides of the epiglottis, aryepiglottic folds, and ventricular bands, and deep ulceration may be observed later on. The ulcers present either a greyish yellow or pinkish granular base, and minute yellowish nodules are occasionally developed in their neighbourhood. In certain instances the vocal cords are split longitudinally into terrace-like reddish or ulcerated ridges, so that each cord seems to be composed of several individual segments. Small tubercular tumours, of a greyish pink colour, may occasionally be seen springing from the cords, ventricles, ventricular bands, or other parts. When the epiglottis is much swollen or hangs backwards, it may be impossible to obtain a view of the rest of the larynx. A similar difficulty is sometimes experienced when the larynx is coated with a copious viscid secretion. The colour of the larynx varies greatly: generally speaking, a greyish pink or pale yellowish tint prevails, contrasting often with localised patches of congestion in the vicinity of ulcers or infiltrations. But this colour, which is very characteristic, is not invariably met with, and general congestion may exist Impaired mobility of the cords is very common; it mostly depends on mechanical fixation of the arytenoid cartilages from surrounding infiltration. At times the vocal cords occupy the median position, simulating bilateral abductor paralysis, and giving rise to severe stenosis. Neuropathic paralysis also occurs. Thus one cord may be motionless in the cadaveric position, midway between that of adduction and abduction. On the right side this condition may occasionally be the result of implication of the recurrent nerve in pleuritic thickening of the apex of the right lung; whereas the left recurrent may be compressed by enlarged bronchial glands as it winds round the arch of the aorta. Imperfect closure of the glottis depending on bilateral paresis of the adductors, as in cases of functional or hysterical paralysis, is a more common appearance. Lastly, in advanced cases of phthisis, aphonia may be unassociated with any defect of movement, the feeble action of the respiratory muscles being insufficient to cause the requisite vibration of the cords. In other instances paralysis is probably of myopathic origin.

Diagnosis.—Chronic laryngitis is sometimes one of the earliest symptoms of phthisis, and therefore should always direct attention to the state of the lungs. The diagnosis of tubercular disease rests on the detection of localised infiltration or ulceration of certain parts of the larynx, in association with physical signs of pulmonary tuberculosis. Syphilis is the disease with which it is most likely to be confounded, and the difficulty is increased by the fact that the two affections may co-exist; some authors even assert that syphilitic ulceration predisposes to tuberculosis. Pronounced pallor of the larynx, swelling of the inter-arytenoid fold, with papillary excrescences, fleshy swelling of one cord, chronic ulcers of the cords, and a pale swollen condition of the aryepiglottic folds and epiglottis, are very characteristic of tuberculosis. On the other hand, marked congestion, rapidly extending ulceration of the cords or epiglottis, and cicatricial contraction, would be in favour of syphilis. Nevertheless, in many cases the laryngoscopic appearances are quite inconclusive; and, should examination of the lungs yield a negative or equivocal result, the detection of the tubercle bacillus in the sputum will alone establish the diagnosis. Tuberculosis can seldom be mistaken for a malignant growth, but the diagnosis will be considered under the latter disease.

Prognosis.—Laryngeal tuberculosis is rarely cured, though spontaneous cicatrisation undoubtedly occurs in exceptional cases. The progress of the disease can often be temporarily checked, and at times is arrested by suitable treatment. As a rule, however, the prognosis is most unfavourable. Infiltration of the epiglottis and aryepiglottic folds has a most ominous significance, owing to the interference with deglutition thereby entailed.

Treatment.—The constitutional treatment is discussed in the article on Phthisis; consequently the local treatment alone will be considered here. Lactic acid, introduced by Krause, is the most efficacious remedy at present known. The writer (P. K.) has seen several cases where permanent cicatrisation of tubercular ulcers has followed the systematic application of this remedy. The larynx must first be well brushed out with a 20 per cent. solution of cocaine; and then, after an interval of three to five minutes, a 40 per cent. solution of the acid should be thoroughly applied on a small piece of cotton wool, fixed to the screw of a laryngeal holder. The strength of the solution should be increased till saturation is reached, and the treatment should be continued for ten days to a fortnight, the applications being made every other day, or in some cases daily. It is extremely important to paint the larynx thoroughly with cocaine two or three times before using the acid, otherwise the application is very painful. If, notwithstanding this precaution, pain be experienced, a weak spray of cocaine to the larynx may be trusted to give relief. The selection of fit cases is a matter of great moment. Real benefit is only to be expected where localised ulceration is unassociated with much submucous thickening. Where deep infiltration exists, radical treatment is out of the question.

A solution of menthol in olive oil, 20 per cent., painted on the larynx, gives much relief to pain and dysphagia, and is said to promote healing of ulcers; but in the last respect it cannot be compared to lactic acid. Insufflation of a powder consisting of boric acid and iodoform equal parts, with cocaine or morphine $\frac{1}{6}$ to $\frac{1}{3}$ of a grain, has also been much praised, but its effects are only palliative.

Painful deglutition can generally be relieved by spraying the throat, a few minutes before food is taken, with a 2 to 5 per cent. solution of cocaine. A lozenge, containing $\frac{1}{10}$ to $\frac{1}{6}$ of a grain of cocaine, also gives relief in less severe cases. Insufflation of morphine, $\frac{1}{6}$ of a grain, with a little starch-powder or sugar of milk, produces less complete analgesia, but the effect lasts rather longer.

In cases where liquids enter the larynx during drinking, as sometimes happens when the epiglottis is destroyed, Dr. Wolfenden recommends that the patient should drink through a tube, lying flat on his face. Thickened drinks can often be taken better than ordinary fluids in such cases. Laryngeal cough may be mitigated by a cocaine spray, the use of menthol or oil of peppermint in an oro-nasal respirator, insufflations of morphine, or by sucking ice.

Tracheotomy is only to be performed when marked stenosis is produced; but this operation is seldom required, and its effects on the pulmonary disease are very unfavourable, on account of the difficulty of expectoration which is experienced when the action of the glottis is abolished by the introduction of a tracheal cannula.

9. **Larynx, Tumours of.**—(*a*) **Benign.** Synon.: Polypi, or Growths of the Larynx; Fr. *Tumeurs, Kystes, et Polypes du Larynx*; Ger. *Kehlkopfpolypen.*

Ætiology.—The invention and use of the laryngoscope, leading to accurate diagnosis, has established the fact that tumours of the larynx are of much more frequent occurrence than was formerly supposed. They are most common in adult males, but they occur in either sex, and at any age from infancy upwards. Inflammatory attacks, syphilis, and anything leading to habitual congestion of the larynx, are said to favour their development.

Anatomical Characters. — Growths of various kinds occur in the larynx, papillomata being much the commonest. These present the appearance of a sessile warty or mulberry-like growth, attached generally to the anterior part of the vocal cords, though they may spring from almost any part of the larynx. Papillomata vary in size from a millet-seed to a walnut, and may be single or multiple. They sometimes show a tendency to recur when removed. Fibromata, the next commonest form of innocent tumour, may be sessile or pedunculated; their surface is usually smooth or slightly lobulated, but in size and localisation they closely resemble papillomata.

All other benign growths are very rare, and it must suffice to enumerate myxoma, lipoma, enchondroma, adenoma, angioma, and cystic tumour.

Symptoms.—Benign tumours may cause little inconvenience; but, owing to the fact that the commoner varieties generally affect the vocal cords, some modification of the voice is almost a constant symptom. A dry spasmodic or croupy cough is sometimes excited. The breathing is but little affected until the growth attains some size, when dyspnœa will set in, at first only on exertion, occasionally spasmodic; as the growth increases, it becomes constant, and at last it may prove fatal if the disease be unrelieved. Tumours attached below the vocal cords are rare; when they exist, and are large enough to interfere with the breathing, expiration is as noisy and difficult as inspiration. These growths are usually painless. They may be so situated as to interfere with swallowing, but this is not usual. In addition to these symptoms, the growth can be seen with the aid of the laryngoscope, and felt with the laryngeal probe or sound, and sometimes with the finger. Occasionally portions of a papilloma are expelled by coughing.

Diagnosis.—A certain diagnosis can only be arrived at by examination of the larynx. The laryngoscope will often, but not invariably, enable us to distinguish a papilloma from a fibroma. The diagnosis of a benign from a malignant growth is sometimes no easy matter, though the absence of ulceration, congestion, or infiltration, which characterises an innocent tumour, is rare in malignant disease. The fact that simple growths hardly ever originate from the inter-arytenoid or aryepiglottic folds will help to distinguish these from the polypoid excrescences that often fringe the margin of tubercular or syphilitic ulcers in these regions.

Prognosis.—The importance of these growths varies with their situation and rate of increase. A few months have sufficed for the growth of tumours from their origin to their attaining a size sufficient to threaten suffocation; in other cases they may exist for years without giving rise to any symptom beyond dysphonia or aphonia. As soon as a growth causes dyspnœa it has become dangerous. The disease must practically be regarded as incurable, except by operation or other local treatment.

Treatment.—A small stationary fibroma or other tumour, giving rise to but little inconvenience, requires no treatment. All other tumours must be removed by operation. Removal may be effected by instruments introduced into the larynx from above with the aid of the laryngoscope; or, where the disease is very extensive, an artificial opening into the larynx (thyrotomy or division of both thyroid and cricoid) may be necessary, the growth or growths being removed through this opening. This is the only feasible method of operation in the case of children. If the growth is removed *per vias naturales*, it may be crushed through at its base by a properly constructed *écraseur*; it may be seized and torn off by forceps; or it may be cut off by knives or scissors. The particular operation, and the instruments to be used, must be determined by the circumstances of the case. The use of a cocaine spray renders such manipulations much easier. The statement which has been advanced that the irritation of endo-laryngeal operations may induce the transformation of innocent into malignant growths has been conclusively disproved.

(*b*) **Malignant.**—Malignant tumours of the larynx may be primary or secondary. Primary growths are far less rare than was formerly thought, carcinoma being much more often met with than sarcoma. Epithelioma is the commonest form of carcinoma, the medullary and scirrhous varieties occurring less frequently. Carcinoma develops as a cauliflower or nodular growth from the vocal cords or ventricular bands, though occasionally other parts are first affected. The tumour, at first localised, tends gradually to involve the whole of one side or more of the larynx. Owing to the infiltrating nature of the disease, the mobility of the corresponding vocal cord is often interfered with. Ulceration is a common occurrence, and may be followed by œdema, hæmorrhage, perichondritis, and necrosis of the cartilages. Carcinoma sometimes shows little tendency to infect the glands and other parts of the body, and sarcoma is even less liable to spread.

Symptoms.—Hoarseness or aphonia is usually the first symptom, but dysphagia and dyspnœa may arise later on. Pain is more pronounced in this than in any other affection of the larynx, and may shoot to the ear. Ulceration is sometimes attended with great fœtor of the breath.

Diagnosis.—The laryngoscopic appearances are seldom characteristic, often closely resembling those presented by innocent growths, especially papillomata. The diagnostic importance of fixation of the corresponding vocal cord has been pointed out by Dr. Semon. Microscopical evidence of carcinoma or sarcoma may sometimes be detected in small portions of the tumour, removed by the laryngeal forceps, and is then of course conclusive.

The diagnosis of syphilis from malignant disease has been already discussed. Tuberculous lesions seldom present the appearance of a localised growth, and careful examination of the lungs and sputum will generally decide the matter. The age of the patient is of some importance, carcinoma being seldom observed before the age of forty.

Prognosis.—The prognosis is unfavourable in all forms of carcinoma, but progress is least rapid in the scirrhous type. Sarcoma of the larynx seems to extend still more slowly.

Treatment.—Partial resection of the larynx has been successful in a few cases of early localised malignant disease, and is the only radical method that seems at present justifiable. Removal of a cancerous larynx was first practised by Billroth, and has since been performed by several Continental surgeons. The results of the operation have, however, been so unfavourable that it cannot be recommended. The obstruction to respiration may demand the performance of tracheotomy; and if the lower part of the trachea is free from disease, the operation will prolong life. Extirpation of a malignant growth by an endo-laryngeal operation should not be attempted.

Pain and dysphagia must be alleviated by the application of cocaine or morphine, as in cases of tuberculosis.

Thomas J. Walker. Percy Kidd.

LATENT (*lateo*, I lie hid).—This word is applied to cases of certain diseases in which their usual characteristic features are obscured and concealed; for example, *latent* *pleurisy, latent scarlatina.* Symptoms are also said to be latent when they do not occur under circumstances in which they ought to appear. For instance, *cough* may be *latent* in certain cases of phthisis.

LAVAGE (Fr.).—Synon.: Ger. *Magenausspülung.*

Definition.—A method of washing out the stomach, introduced by Kussmaul.

Description.—In order to perform lavage it is necessary to be provided with the following: (1) A soft flexible gastric catheter or stomach tube, about twenty inches in length; (2) a large-sized glass funnel; (3) about a yard of india-rubber tubing; and (4) some suitable lubricating material.

The glass funnel or receiver is affixed to the one end of the gastric catheter by means of the india-rubber tubing, which may be interrupted at one part by the insertion of a small piece of glass tubing, so that the observer can determine when the irrigation is complete by noticing that the returning fluid is quite clear. The free or distal end of the stomach tube is provided with good-sized lateral oval openings, placed a short distance from its rounded end.

Having lubricated the tube with glycerine, the practitioner introduces it into the pharynx with his right hand, and gently presses it down, whilst the patient, who is preferably in the sitting posture, performs the act of swallowing. The sensibility of the pharynx, if it be excessive, may be subdued by the usual appropriate measures.

To charge the apparatus, it is only necessary to fill the receiver with fluid, and, having filled it, to raise it above the patient's head, and to keep adding fluid until by its regurgitation we know that a sufficient quantity has been used. A syphon action can now be established by depressing the funnel. The stomach is thus emptied; and by repeatedly filling and emptying it as described, it can be thoroughly washed out. The repugnance some patients have to the use of the tube is generally soon overcome, and with a little practice a patient generally acquires the requisite manipulative skill to introduce the syphon tube himself; but it is necessary to encourage him to persevere with its use, which in many cases may necessarily be of long duration.

The fluid which may be employed in lavage may be either lukewarm water; 1 per cent. salt solution; 3 to 5 per cent. solution of bicarbonate of sodium; 3 per cent. solution of either boric acid or borax; or other such familiar substances possessed of antiseptic or antifermentative properties.

In the beginning, lavage may be resorted to once or twice daily, less frequently afterwards as the case improves.

Uses.—Lavage has been employed for *diagnostic* purposes, as it affords a simple and highly efficient means of removing the contents of the stomach for chemical investigation in certain gastric disorders.

Lavage is one of the most important among the numerous *therapeutic* measures which are at our command for stimulating the activity of the gastric glands in cases of chronic dyspepsia, especially in those instances which are associated with excessive secretion of mucus.

By its employment we may also increase peristaltic action, strengthen the enfeebled gastric muscular fibres in cases of insufficiency or atony, remove fermenting and stagnant gastric contents, thereby cleansing the gastric mucous membrane. With the improvement in the tone of the walls of the stomach, associated intestinal disorders such as constipation may also be overcome.

Amongst the diseases in which lavage has been successfully employed may be mentioned simple gastric dilatation, due either to perversion of function or to mechanical obstruction; chronic gastritis; and intractable cases of chronic dyspepsia. *See* Stomach, Diseases of.

It should be remembered that there are certain possible dangers in connexion with lavage. The chief of these are injury to the œsophagus or to the gastric walls, with hæmorrhage, or perforation. Fatal syncope even has attended its use; but such cases are fortunately of extreme rarity.

John Harold.

LEAD, Poisoning by.—Synon.: Plumbism; Fr. *Intoxication Saturnine*; Ger. *Bleivergiftung.*

Pure metallic lead has probably no injurious action on the system; but owing to the ease with which it oxidises and forms salts, all of which are poisonous, lead-poisoning is of common occurrence amongst all persons whose occupation brings them much in contact with metallic lead and its alloys; among those engaged in industries in which lead-salts are manufactured or largely employed; as well as from contamination, accidental or otherwise, of articles of food, drink, or luxury with lead or its compounds.

Acute poisoning with lead is not common, nor are any of the lead-salts actively poisonous. The acetate or 'sugar of lead' is popularly believed to be a virulent poison, but it is by no means so. There are very few fatal cases on record, even from swallowing quantities amounting to an ounce of the acetate, or its equivalent. The symptoms are in the main those of irritant poisoning, the chief difference being that constipation is the rule, and diarrhœa the exception.

The *chronic* form of poisoning by lead is of infinitely more importance and prevalence. The sources of it are extremely numerous and varied, and it is almost impossible to specify all individually. The following are among the chief, classified according to the primary form of the poison.

1. **Metallic Lead, Poisoning by.**—Lead-poisoning occurs among lead-miners, metallurgists, and workers in lead or its alloys, such as plumbers, solderers, type-founders, compositors, and manufacturers of lead toys (toy soldiers). It has been observed also among fishmongers, from using lead counters; in pot-boys; as the result of packing articles of food or luxury in lead-foil; and from contamination of articles of drink by shot used for cleaning bottles, siphon soda-water bottles, &c.

Under this head may also be included the very frequent contamination of *drinking-water* by lead pipes and cisterns. Pure water, free from gases and excluded from contact with air, does not act upon lead, but in presence of air the lead becomes speedily acted on, and the water contaminated. An oxide of lead is formed, which, being partially soluble in water, allows the action to go on. From its solution the oxide is in great measure precipitated by carbonic acid, which is absorbed. The lead falls as an oxycarbonate, though the presence of carbonic acid in the water keeps a certain quantity in solution. The purer the water the more rapid the action. The presence of certain salts in the water considerably modifies its action on lead. Thus the nitrates, nitrites, and chlorides, by forming soluble compounds with lead, increase the solvent action of the water; and as these salts usually result from sewage-contamination, such water is rendered still more dangerous by passing through lead pipes. Other salts, usually found in spring and river waters, act as protectives by forming insoluble lead-compounds, which, being deposited as a crust in the interior of the pipe or cistern, prevent further action. Of this class are the sulphates, phosphates, and carbonates. Hence waters, unless containing much less than the average proportion of lime-salts, after a time cease to be contaminated to any great extent, though the presence of carbonic acid in the water renders a solution of the crust possible in some measure. Waters so deficient in lime-salts as the Loch Katrine water supplied to Glasgow cannot safely be conveyed in lead pipes. Galvanised iron, earthenware, or slate may in many cases be advantageously substituted for lead, if not possible in all. Lead covers to cisterns are very objectionable, as the water which rises by evaporation condenses and drops back contaminated. The electrolytic action of solders also helps to contaminate water with lead.

2. **Oxides of Lead, Poisoning by.**—The most important oxide of lead in this relation is litharge, or plumbic oxide (massicot), which is largely used in making glass and glazes for earthenware and iron. Those engaged in glass making and grinding, glazing pottery, &c., suffer. Owing to the solubility of lead-glazes, articles of food if acid may be contaminated, as by the artificial wines made in glazed jars decomposing the oxide by their fermentation. Litharge is also used for hair-dyes, japanning, &c., whence poisoning may result.

The 'red lead,' which is a mixture of lead oxides, has caused poisoning by being used to colour wafers, adulterate snuff, and make putty or cement for tanks, &c.

3. **Lead Salts, Poisoning by.**—Of these the most important in this relation is the carbonate, or 'white lead.' Those engaged in the manufacture, grinding, and packing of white lead are the most frequent sufferers, and also those who largely use it, such as painters, glaziers, plumbers, glazed card manufacturers, lacquerers, lace manufacturers, and those who apply it as a cosmetic (clowns, &c.). The acetate of lead has been used for correcting the acidity of wine and cider, and has been a frequent source of lead-poisoning. Poisoning has also occurred among seamstresses from using silk thread adulterated with it; in dye-works, where it is largely used; from using it as a hair-dye; and from long-continued medicinal administration. Lead colours, chromates, &c., have also caused poisoning, by being used to colour confectionery. (See a series of cases by Marshall, *Med. News*, 1887.) From these and similar sources lead may be introduced into the system by inhalation, ingestion into the stomach, and apparently also by cutaneous absorption.

SYMPTOMS.—The affections caused by lead are frequently termed *saturnine*, owing to lead being the symbol of Saturn, the malign planet of the astrologers. They are of a manifold character, and do not always occur in regular order or sequence.

Saturnine Cachexia.—As a rule, after long-continued introduction of lead into the system, a saturnine cachexia is developed, characterised by anæmia, an earthy or dull hue of the skin, digestive derangement, dryness of the mouth, frequently a styptic or sweetish astringent taste, coated tongue, and fetid breath. The teeth are discoloured, and frequently appear elongated from retraction of the gums. At the margin of the teeth and the gums a bluish or violet line is developed. This, which is regarded as the specially diagnostic indication of lead-poisoning, was first described by Burton, and is shown to be due to the formation of a lead sulphide in the parts.

Lead Colic.—SYNON.: *Colica Saturnina*; Fr. *Colique de Plomb*; Ger. *Bleikolik.*—Following the symptoms just described, but sometimes without marked prodromata, a very characteristic affection occurs, namely, lead colic. This is known by many other synonyms, of which the more common are Painter's Colic, Devonshire Colic, Colica

Pictonum, the last being derived from the inhabitants of Poictou, among whom in modern times it was first extensively prevalent owing to adulteration of wine with lead-salts.

Patients affected with lead colic exhibit a cachectic look, earthy hue, blue line on the gums, coated tongue, and fetid breath; and suffer from nausea and, occasionally, vomiting. The bowels are obstinately confined, or scanty hard motions are passed with difficulty. Paroxysms of excruciating pain occur in the abdomen, which feels hard, and is retracted in the region of the umbilicus. The pain is of a truly colicky nature, and is relieved by pressure. The countenance is anxious, and the skin is covered with cold perspiration. The respiration is shallow, and the pulse generally slow and hard, though this is not always the case. The urine is not infrequently almost or entirely suppressed.

Lead Palsy.—SYNON.: Fr. *Paralysie Saturnine*; Ger. *Bleilähmung.*—After repeated attacks of lead colic, or it may be after one, and sometimes without antecedent colic, various other affections occur. One of the most common of these is a form of paralysis termed 'lead palsy,' or, from its special features, 'dropped wrist.' The paralysis shows itself more particularly in the extensor muscles of the forearm, or region of distribution of the musculo-spiral nerve; and in consequence, when the arm is raised, the hand drops by its own weight. The paralysis generally commences in the extensor digitorum communis, and gradually extends to the other muscles supplied by the musculo-spiral, with the remarkable exception of the supinator longus. The paralysis does not necessarily confine itself to the forearm, for in advanced cases it may attack other muscles in the arm, the muscles of the leg, and the dorsal muscles; showing itself by preference in the extensor and abductor muscles of the body, and giving rise to a peculiar stooping, tottering gait. Aphonia occasionally results. The paralysed muscles undergo atrophy; while they lose their faradic, and in incurable cases also their galvanic, excitability. *See* NEURITIS, PERIPHERAL.

Other phenomena.—Tendinous swellings of an oval or elongated shape frequently form on the tendons at the back of the wrist, and contrast prominently with the atrophied muscles. Neuralgic pains in the muscles and joints are often complained of. In the more advanced cases various forms of encephalopathies occur. Epileptiform convulsions, with headache and optic neuritis, are common; and psychical affections are not infrequent, in the form of delirium, mania, or melancholia. Apparently in causal relation with lead-poisoning, disease of the kidneys and albuminuria may occur; and gout is frequently seen among those who work in lead (*see* BRIGHT'S DISEASE; and GOUT). Abortion occurs to a large extent among women employed at white-lead works; according to Paul, in the proportion of 60 per cent. of those so employed.

The tendency is to recovery, if the cause of the symptoms is removed; but if not, the paralytic and other affections become incurable, and death occurs in a miserable state of cachexia.

ANATOMICAL CHARACTERS.—There are no very characteristic appearances of chronic lead-poisoning. Lead is found in almost every organ and tissue in the body, the greatest quantity, according to Heubel, being found in the bones; next in the kidneys, liver, brain, and spinal cord; and to a less extent in the muscles.

Among the appearances which have been described are constriction and apparent thickening of the muscular coat of the large intestine; and an atrophic condition of the intestinal mucous membrane has been found by some authors (Kussmaul and Maier). These authors have also found an increase of the connective tissue, and atrophy of the nervous tissue in the abdominal ganglia of the sympathetic. The paralysed muscles exhibit atrophic degeneration, with hyperplasia of the connective tissue, and disappearance of the striæ; while the nerve-trunks likewise exhibit various stages of inflammation or atrophy. We possess, as yet, no very reliable knowledge of the condition of the nerve-centres. Degeneration has been found in the nerve-cells of the brain, as well as in those of the anterior horns of the spinal cord.

The mode of action of lead in the causation of the various symptoms induced by it is not in all respects satisfactorily determined. The paralytic affections seem, however, to be essentially due to its action on the peripheral nerves, and the special action on extensors and abductors appears to be due to a special proclivity on their part to influences acting on the nervous system in general. The intramuscular nerves, in cases of lead-palsy, have been found in a state of inflammation; and a similar condition has been developed in animals as the result of chronic poisoning. The anterior cornua of the spinal cord, though sometimes affected, have been found normal in cases where the palsy has been well-marked, and the peripheral nerves in a state of inflammation.

TREATMENT.—In *acute* lead-poisoning from any cause the stomach must be emptied by the stomach-pump, or by emetics—of which sulphate of zinc is to be preferred. Solutions of the alkaline or earthy sulphates—of which the best is sulphate of magnesium—are indicated, with the view of forming the comparatively insoluble sulphate of lead, and expelling it from the intestines.

As regards *chronic* poisoning by lead, prophylaxis is the most important consideration. The great principles in lead-works are the inculcation of cleanliness; avoiding eating with unwashed hands, or in working clothes, or in workshops; moist grinding; free ventilation; precautions against dust rising, or wearing of flannel respirators where it is unavoidable; and occasional doses of sulphate of magnesium, acidulated with sulphuric acid. Sulphuric-acid lemonade has been recommended as a drink.

Workmen who begin to show signs of lead-poisoning should at once give up the work, and take to some other employment. As regards water-contamination, what has already been said on this subject will suffice to indicate the prophylactic measures.

In the treatment of *lead colic* purgatives are indicated, and opium or belladonna may be necessary to allay the excruciating pain. The sulphate of magnesium is the best purgative. Iodide of potassium is generally given with the object of removing the lead from the system, and is on the whole satisfactory in its results. A combination of this iodide with sulphate of magnesium is very beneficial. Sulphur baths are also recommended.

The local *paralytic* affections require local in addition to the general treatment. Unless the muscles are in an advanced state of atrophy, and give no response to electrical stimulation, good results may be obtained from the use of the galvanic current applied to the muscles and to the musculo-spiral nerve. Faradisation has also been found beneficial, and is recommended by Duchenne, but the preference is to be given to the continuous current. D. FERRIER.

LEAMINGTON, in Warwickshire.—Sulphated common salt waters. *See* MINERAL WATERS.

LEECHING.—The local abstraction of blood by means of leeches. *See* BLOOD, Abstraction of; and DEPLETION.

LENK, in Switzerland.—Sulphur waters and climatic health resort. *See* MINERAL WATERS.

LENS, Diseases of.—*See* CATARACT.

LENTIGO.—A synonym for freckle. *See* FRECKLES.

LEPOTHRIX (λεπίς or λέπος, a scale; and θρίξ, a hair).—DEFINITION.—A term applied to a hair in which there is loosening and partial detachment of the overlapping edges of the scales of its cuticle.

Such hairs are usually met with in the axilla, and their peculiar conformation is attributable to the heat and dampness of that region, which causes maceration of the hair, particularly when it is of feeble structure. Sometimes the scales completely surround the hair; very commonly one side of the shaft is more affected than the rest, and presents the appearance of a fringe; and not infrequently the scales are roughened with earthy and saline crusts deposited by the sweat.

TREATMENT.—The treatment most suitable for this evil is saponaceous ablution, followed by the use of a lotion composed of two to four drachms of oxide of zinc to half a pint of lime-water. ERASMUS WILSON.

LEPRA.—*See* LEPROSY.

LEPROSY (λεπρός, scaly). — SYNON.: Lepra; Leontiasis (old); *Elephantiasis Græcorum*; Fr. *Lèpre*; Ger. *Der Aussatz*.

DEFINITION.—A chronic general disease; characterised by structural changes in the skin, mucous membranes, and nerves; leading to the production of new morbid tissue, and giving rise to great disfigurement of the features and deformity of the extremities; and under certain conditions communicable from person to person by inoculation.

NOMENCLATURE.—The large number of names that have been applied to leprosy at different times has rendered the nomenclature difficult and obscure. Without going into the question of the early names, which are very numerous, we find that even the modern nomenclature is confusing. Willan and Bateman, and also Erasmus Wilson, following Hippocrates, have used the term 'lepra' to indicate the disease now universally known as psoriasis; while on the other hand the word 'elephantiasis' has been applied to two distinct diseases, namely, leprosy and the 'Barbadoes leg.' It will be well in future to reserve the word 'lepra' for leprosy, and to allow the other names that have been applied to drop out of use.

HISTORY.—All writers agree in regarding Egypt as the early home of leprosy, and it is highly probable that the Jews carried it with them when they migrated from that country to Palestine. The Biblical accounts of the disease, though highly interesting, are of no scientific value, as the writers evidently included more than one malady under the name which is translated 'leprosy.' In support of this view, it may be mentioned that the recovery of some of those afflicted with the disease is evidently assumed as highly probable, and provision is made for their readmission into Jewish society. It is also quite evident that the leprosy of Naaman and Gehazi, mentioned in the Book of Kings, was a form of leucoderma, still very common in the East, especially in India, and known as 'white leprosy.' The earlier Greek medical writers give no clear account of leprosy; therefore we may assume that they were but little acquainted with it. Aretæus, however, who lived in the first century, gives an admirable description of it, which it would be difficult to improve upon in the present day.

During the Middle Ages leprosy spread continuously from Eastern to Western Europe, and it is generally believed that the Crusades contributed in no small degree to this result. It is, however, certain that the disease existed in Western Europe prior to the first Crusade. During the twelfth and thirteenth centuries leprosy increased to a terrible extent, especially in England, Italy, and France. Vellay, in his history of the latter country, says that Louis VIII. promulgated a code of laws in 1226 for the regulation of leper-hospitals in France, and that the number of these hospitals was computed at that time to be not less than two thousand. At a later period the number had increased, so that there was scarcely a town in the country unprovided with a leper-house. The late Sir James Simpson collected records from the *Monasticon Anglicanum* and other sources of no less than ninety-five religious hospitals for lepers, besides innumerable smaller pest-houses, nearly all of which were founded in Great Britain during the twelfth, thirteenth, and fourteenth centuries. In addition to these, there were at least fourteen houses of the first order in Ireland. The total number of similar institutions in Europe was estimated by Matthew Paris at nineteen thousand, but this probably included houses of the smaller class. It is interesting to note that no new leper-hospitals were built in England after the fifteenth century. The last one of any note was founded at Highgate in 1472, but long before that time many of the old leper-houses had fallen into disuse, and their revenues had become diverted to other purposes. On the Continent, Hensler has clearly demonstrated that towards the end of the fifteenth century scarcely a trace of tuberculated leprosy could be found in any of the more civilised parts of Europe. The disease has, however, continued to exist up to the present day in a few isolated spots, especially the west coast of Norway about Bergen, Iceland, and in some parts of Spain. There can be little doubt that the isolation of lepers during the twelfth, thirteenth, and fourteenth centuries contributed largely to the almost complete extinction of the disease in Europe in the following century.

Geographical Distribution.—There is no disease that has a wider geographical distribution than leprosy. It is found both in the northern and southern hemispheres, and in almost every latitude from the poles to the equator. It is, however, far more common in the tropical than in the temperate regions.

In Europe, leprosy has almost disappeared as an endemic disease. It is nevertheless met with in Western Norway, Iceland, Lapland, and the Russian shores of the Baltic, in certain parts of Spain and Portugal, and along the coasts of Provence and Nice; but in all these places it is confined to a small portion of the population, and, with the exception perhaps of Spain, is generally dying out. It is also sparsely distributed in Greece and European Turkey and most of the islands of the Mediterranean. In addition to these districts, in which the disease may be said to be still endemic, we meet with a considerable number of imported cases scattered throughout Europe. This fact especially holds good with regard to England, and is obviously the result of her possession of India, Burmah, and the West Indian Islands.

In temperate North America leprosy is rare; it has, however, long been established amongst the French population of the Canadian province of New Brunswick, and it exists also at Cape Breton Island off Nova Scotia. Imported cases are, of course, occasionally met with just as they are in Europe.

In tropical America, both North and South, including the West Indies and the Bermudas, the disease is very common. Its presence in the Sandwich Islands is of comparatively recent date, and it is believed to have been introduced by the Chinese. Prior to the year 1848 it was unknown, yet by 1866 the number of lepers was reported to be 230, and by 1882 it had further increased to about 4,000. An asylum for lepers has been established in the island of Molokai, where there is now a settlement containing upwards of 1,000 sufferers. This extraordinary increase of leprosy in the Sandwich Islands since 1848 seems to point to some mode of propagation of the disease more rapid than inoculation.

With regard to Africa, it has already been stated that Egypt was the birthplace of leprosy, and it exists there to the present day; indeed, there is scarcely any part of Africa that is entirely free from the disease. It is, however, especially rife on the west coast, and is also met with in the Azores, Madeira, and the Canaries. On the east side it is very prevalent in Madagascar and the coast opposite. In Cape Colony it is met with not only among the native populations, but has also spread among the Dutch settlers. The writer has himself had under his care two Boers from the Transvaal suffering from it.

Of all quarters of the globe Asia contains the largest number of lepers. The disease is found in Syria, Persia, Turkey, and Arabia, and is especially common in Russia on the western shores of the Caspian. Its prevalence in India, Burmah, and the islands of the Indian Ocean is notorious; while Southern China may be regarded as a centre from which it has spread to many other parts of the world.

The history of leprosy in Australia is equally remarkable with that of the Sandwich Islands. Thirty years ago it was unknown among the European settlers, but has apparently been introduced chiefly, if not entirely, by the Chinese, from whom it has now spread to the Europeans. The writer has met with three cases of the kind in employers of Chinese labour.

Taking a general view of the distribution of leprosy throughout the world, two questions especially suggest themselves: (1) Is it to any considerable extent on the increase? and (2) Is it capable of being transferred from one country to another by the exportation of lepers? With regard to the first of these questions, it seems probable that in most civilised countries the disease is on the decrease, but that here and there centres may be found where the reverse of this is the case. As to the second question, there can be no doubt whatever that the introduction of lepers amongst a new population leads to a dissemination of the malady.

Ætiology.—During the Middle Ages the wildest notions were entertained as to the causes of leprosy. Some held that it was produced by an excess of animal food, while others believed that a vegetable diet had the chief share in its production. The combination, however, of milk and fish seems to have been considered as especially favourable to the development of the disease. Bernhard Gordon says: 'Comedere lac et pisces in eadem mensa inducit lepram' (*Lilium Medicinæ*). This curious and unaccountable belief, that such a terrible disease as leprosy could be produced by eating fish, has continued even down to the present time. It may be stated positively that neither climate, race, soil, nor food can by any possibility originate leprosy *de novo*, but that each and all may contribute to its perpetuation in those countries where it already exists, and that general improvement in hygiene will contribute not a little to the stamping out of the disease. Dismissing, then, these causes as at most only contributory to its perpetuation, it is necessary to consider two very important questions: (1) Is it hereditary? and (2) Is it contagious?

Heredity.—Five-and-twenty years ago the hereditary nature of leprosy was generally considered one of the best-established facts with regard to the malady. Nevertheless, even at that time such able and distinguished men as Virchow and Kaposi pointed out that it could not be *hereditary* in the strict sense of the word—that it was never, for example, inherited in the same way as syphilis is; and that if the word 'hereditary' was applied at all, it could only be used in the sense of *predisposition*. The belief in the hereditary nature of leprosy is easily explained, and originated in the fact that it was often met with in different generations of the same family living together; and as its inoculability was overlooked, there seemed no other explanation for the facts observed. At the present time these facts can be easily accounted for on the supposition that it is inoculable, and hence a belief in its hereditary nature has almost entirely died out.

Contagion.—There is no disease about which so much has been written in former times as leprosy, and there is no disease the nature and history of which have been more thoroughly investigated at the present day. The only problem about which until lately some doubt remained was as to its contagious nature, and that problem is now being rapidly solved, if indeed the solution has not been already completed. The evidence in favour of contagion is of two kinds—(1) indirect or inferential; and (2) direct. The former is based on the fact that in recent times the disease has apparently been imported into new countries, formerly quite free, by the introduction of lepers; this is notably the case with regard to the Sandwich Islands and Australia. The more direct evidence is that of individual cases of inoculation; and, of the two kinds of evidence, the latter is of course the more satisfactory. About a quarter of a century ago the conclusions arrived at by a leprosy committee of the Royal College of Physicians, after a most careful investigation of the subject, were as follows: 'The all but unanimous conviction of the most experienced observers in most parts of the world is quite opposed to the belief that leprosy is contagious, or communicable by proximity or contact with the diseased. The evidence derived from the experience of the attendants in leper asylums is especially conclusive upon this point. The few instances that have been reported in a contrary sense either rest on imperfect observation, or they are recorded with so little attention to the necessary details as not to affect the above conclusion. That leprosy is rarely if ever transmissible by sexual intercourse when one of the parties has no tendency whatever to the disease, is the opinion of the great majority of the respondents who have had the largest opportunities of observation.'

Those writers who have commented unfavourably on the above conclusion of the College of Physicians appear to have lost sight of the fact that the question of inoculability is hardly dealt with, the satisfactory evidence before the College at the time on that point being almost *nil*. All that is stated is that the disease is not contagious or communicable by proximity or contact with the diseased, and this statement in the ordinary acceptation of the words holds good at the present day. During the last five-and-twenty years much stronger evidence has been adduced in favour of the conclusion that the disease is communicable from person to person by inoculation. The following cases alone are sufficient to satisfy the minds of all unprejudiced persons on this point. In 1877, Dr. Hawtrey Benson published the following case: In 1872 he had shown to the Medical Society of Dublin a man who had contracted leprosy in the

West Indies, where he had lived twenty-two years. After remaining a certain time in the hospital he returned to his Irish home, and died after about a year and a half. During this latter period his brother slept in the same bed with him and wore his clothes. His brother, who had never left Ireland, except forty-six years before, when he had passed some time in England, became a leper and was shown in 1877 to the Medical Society of Dublin. There had been no other cases of leprosy known in the family. In the same year the writer published the following case: J. L., aged twenty, a native of Guernsey, was admitted into Middlesex Hospital in an advanced stage of tuberculated leprosy on July 12, 1877. His father, a native of Birmingham, was a soldier who had served in India, and died aged about fifty-five; his mother was a native of the island. His father when in India cohabited with a coloured woman, and died in Guernsey from a disease the description of which exactly corresponded with tuberculated leprosy. He had sores on his fingers and toes, enlargement of the nose and ears, and discoloration of the skin of the face. J. L. at the time that he was admitted into the hospital had suffered for five years from the disease, which had become fully developed before he left his native island; he had several brothers and sisters older than himself, all quite healthy. This case was considered at the time by those interested in the subject as strong evidence in favour of the inoculability of the disease. Dr. Gairdner in 1887 published in the *British Medical Journal* a very interesting account of the apparent transmission of the leprous virus by vaccination. The history was briefly as follows: An English medical man living in a tropical island where leprosy is endemic, vaccinated his own son from a native child who turned out to be leprous; from his own son he vaccinated another boy, the son of a Scotch sea-captain trading from Scotland to the island in question. Both his own son and the son of the sea-captain subsequently developed leprosy during childhood. It is a fair inference, but not of course a certainty, as the disease is endemic in the island referred to, that the leprosy was transmitted by inoculation.

The conclusions to be derived from the well-known experiment by Dr. Arning in Hawaii of inoculating a criminal with leprous virus, whose sentence of death was commuted on the condition that he should submit to the operation, were somewhat vitiated by the surroundings and previous history of the individual. It is true that he developed leprosy after, and probably, but not *necessarily*, in consequence of the inoculation.

The present leprosy committee of the College of Physicians, having these and many other cases before them, thought it right to slightly modify the conclusions at which their predecessors had arrived; and they pointed out that, though leprosy is not contagious in the common sense of that term, yet that it is probably so in a minor degree, and they compare it in this respect with syphilis.

Taking all points into consideration, it can hardly be doubted that this conclusion is the right one, and that leprosy, at all events in its later stages, when open sores are present, may become a source of danger to others. On the other hand, in the earlier stages of the disease, it seems highly probable that it is not contagious even in a minor degree.

The oft-quoted history of the Sandwich Islands, and also the accounts from certain districts in Spain, where the disease has spread in modern times with great rapidity over a limited area, are facts not easily explained on the assumption that the disease is propagated only by inoculation, the time occupied being apparently too short. To meet this difficulty the writer suggested in his *Goulstonian Lectures* in 1872 the hypothesis that the leprous poison (the bacillus was not then discovered) might be conveyed, like that of typhoid fever, through water or uncooked food: for example, a leper with open sores might bathe or wash his clothes in a tank used by others for drinking purposes, and thus the germs of the disease would be conveyed to others. This hypothesis involves, however, the supposition that the leprous germs can exist and multiply apart from the human body in the same way that those of typhoid fever and cholera do, and at present there is no evidence to show that this is the case.

Anatomical Characters.—A general description of the more obvious visible changes produced in the organism by leprosy will be presently given. These changes are for the most part confined to the skin, mucous membranes, lymphatic glands, cutaneous nerves, and other superficial structures, which all become gradually but irregularly infiltrated and thickened by the new leprous tissue, the deeper structures of the body remaining unaffected. Dr. Thin says: 'If a vertical section is made from a leprome of the skin, and examined under the microscope, the chief morbid change found is that large clusters of cells have taken the place of bundles of connective tissue which are broken down. Very often, if the leprome is not advanced towards the ulcerative stage, a thin band of sound, unbroken connective tissue is observed between the rete mucosum and the affected part of the corium, which may be found the seat of a dense infiltration of cells. The cells are very similar to the so-called "granulation cells" observed in lupus and in syphilis. In the centre of a group of such cells in a lupus tissue one or more sections of enlarged blood-vessels filled with granular material may be discovered—the so-called "giant cells" of authors. "Giant cells" are referred to by several authors in connexion with leprosy, but in a very large number of sections which have been examined by us we have not observed the characteristic appearances described by ourselves and others in lupus vulgaris. The cells in leprosy vary in size from that of an ordinary white blood-corpuscle to double and even four times that size and more. If specially stained for the purpose, it is seen that these cells contain leprosy bacilli, the smallest of them containing a few, the largest of them masses of bacilli matted together.'

The leprous bacillus was first discovered by Hansen. It bears a very close resemblance to the tubercle bacillus, so close, indeed, that it is exceedingly difficult to distinguish the one from the other. It has even been suggested that the leprous and the tubercle bacillus are identical; if this, however, were the case, the conclusion would be unavoidable that the bacillus has very little to do with either the one disease or the other, a conclusion which would not be accepted for a moment by bacteriologists. The bacilli are found in great abundance in the discharge from open leprous sores.

Symptoms.—Three varieties of leprosy have usually been described by authors—(1) *tuberculated*; (2) *anæsthetic* or 'mutilating;' and (3) *macular* leprosy. There is, however, no essential difference between these three forms, the last being simply an early stage of the other two, while tuberculated leprosy differs from mutilating leprosy chiefly, if not entirely, in respect of the tissues involved.

The general symptoms of the disease belong to all its forms, but they vary much in severity in different cases. The invasion of the disease is usually slow and insidious; in exceptional cases, however, the onset is acute, and the symptoms develop with great rapidity. The malady is rarely met with in infants under the age of two or three years; and is equally common in males and females. The period of incubation is very uncertain, and may generally be reckoned by years rather than by months or days. The early symptoms of the malady consist of general constitutional disturbance, debility, mental depression, loss of appetite, a sense of chilliness, and slight recurrent febrile attacks. All these symptoms may subside for a time, but sooner or later they return; associated with them we meet with slight alterations in the pigmentation of the skin, and temporarily impaired sensibility over limited areas. Occasionally the development of scattered blebs resembling those of pemphigus is met with as an early feature, especially when anæsthesia is present. Blebs also appear sometimes at a later stage.

Tuberculated leprosy is the most severe form of the disease. It begins with the usual symptoms just indicated; after these have lasted with more or less intermission for months or years, the first characteristic changes in the skin appear. These consist of spots resembling some form of erythema, which develop during one of the febrile attacks. They are of a dull brown or reddish brown colour, tender to the touch, often slightly swollen, and varying in size from half-a-crown to that of the palm of the hand, or larger; they partly disappear on pressure, showing their hyperæmic character. These spots are always roughly symmetrical, and are most frequently seen on the extensor surfaces of the extremities, but sometimes on the face and trunk. After a short time their hyperæmic nature disappears, leaving a patch of skin discoloured, and perhaps a little thickened. In dark races, portions of these patches are often paler than the normal skin, giving a somewhat piebald appearance; but in Europeans the skin is for the most part darker than normal, the idea that lepers are usually white being a common popular error. Some of the spots after a time entirely disappear, while others lead more or less to slight permanent changes. Associated with these changes in the skin we often find the superficial nerves affected, so that patches of partially anæsthetic skin are produced. These are for the most part only temporary, the skin sooner or later resuming its normal sensibility.

All the above-mentioned symptoms may reappear and subside over and over again without much permanent alteration in the skin, except perhaps a little discoloration; but ere long we notice a slight permanent change in the face, which is not easily mistaken. The skin a little below the eyes looks rather swollen and puckered, the nose appears somewhat thickened, the patient at the same time complaining of not being able to breathe quite freely through it, and the tone of voice is a little altered in consequence; he speaks, as we say, through the nose. As a further and later change, characteristic tubercles develop in the skin, especially on the face and hands; these swellings are tender on pressure, and produce much thickening of the tissues and consequent alteration of the features. The forehead becomes tuberculated and its wrinkles deepened, the eyebrows somewhat overhanging, which gives a peculiar heavy and leonine expression to the countenance; the hair of the eyebrows is quickly lost; the nose becomes tumid with nodules; the cheeks are irregularly thickened and puckered; the lips hard, swollen, and sometimes everted; the chin is nodulated; and the ears, greatly enlarged, stand out stiffly from the side of the head; the whole appearance is hideous and revolting. One striking effect of the deepening of the furrows and wrinkles of the face is to make young people look prematurely old. Coincidently with these changes in the face, the dorsal aspect of the hands and feet may be similarly affected: the skin becomes brown, and the fingers, greatly enlarged, stand stiffly apart; the nails become dull, dry, and fissured. Some of the tubercles of leprous tissue shrink, while others ulcerate and leave open sores, very difficult to heal. Sooner or later the mucous membrane of the mouth, tongue, and throat becomes altered and thickened, and the voice assumes a hoarse whisper, which is very characteristic of the disease. The eyes also suffer; the cornea becomes opaque, and a partial or complete loss of sight is the consequence. The invasion of the cornea by leprous infiltrations constitutes one of the most common and hopeless features of the malady. Together with these visible changes in the skin and mucous membrane we find alterations occurring in the nerves, and leading to the formation of patches of permanently anæsthetic skin, which vary very much in size, and are met with chiefly on the forearms, hands and feet, and legs below the knee, more rarely on the trunk. In fact, in ordinary cases, the new-growth and structural changes are confined to the face, ears, hands, feet, forearms, and legs, the mucous membrane of the nose, mouth, and throat, and the nerves of the extremities. The ulnar nerve is particularly liable to be affected, and a nodulous swelling of its trunk may be easily felt just above the point where it crosses the elbow-joint. Gradually, though not uniformly, these symptoms increase, the health becomes greatly enfeebled, the temperature is often slightly below normal, the vital powers are exhausted. Sooner or later, some internal complication arises, and the unhappy victim is carried off after years of suffering, by some disease of the lungs or kidneys.

Anæsthetic or *mutilating leprosy* differs in no essential from the tuberculated form, and for the most part we meet with what are called mixed cases—that is, tuberculated leprosy in which the nerve-lesion forms a marked feature, the most important point of distinction being that when the nerve-lesion is considerable, a destruction or mutilation of the fingers and toes is more liable to occur. The distal phalanges are especially apt to be affected and the bones destroyed, so that we sometimes see the nail transferred from the distal to the second, or even to the proximal phalanx, the intervening bones being lost. In other cases, great atrophy and stiffening of the fingers occur. The final falling off of the fingers and toes is for the most part unattended with pain. In other respects, mutilating runs much the same course as tuberculated leprosy, though it is often more protracted.

Diagnosis.—Fully developed lepra is distinguished by such characteristic symptoms that it cannot be easily mistaken for any other disease. This is not, however, the case in an earlier stage, when the symptoms are but slightly marked. The skin may present a perfectly healthy appearance, and the evidence of disease may be limited to some slight anæsthesia of the extremities. Occasionally an eruption of blebs has been mistaken for the onset of pemphigus. Leprosy is, however, far more often mistaken for syphilis than for any other disease. This is not to be wondered at, as the two have an undoubted resemblance, and the differential diagnosis is rendered more difficult when the patient has previously suffered from syphilis. The loss of sensibility in the skin, which is so common in the former disease, will serve as a valuable aid in the differential diagnosis. Later on, the tubercles of lepra may be distinguished from those of syphilis by their much slower development, and their less tendency to soften.

Leucoderma, in which the skin assumes a somewhat piebald appearance, has often been mistaken for an early stage of lepra. This mistake is more liable to occur amongst the dark Oriental races than amongst Europeans.

Lastly, the writer has known this serious disease mistaken for some harmless form of erythema.

Prognosis and Treatment.—The writer has had more or less under his care, during the last twenty years, about forty cases of leprosy, of which some have been watched for many years. The number is absolutely small, though relatively large for a country in which the disease is not endemic. Out of this number, in two only has the disease apparently died out. One of the two cases referred to, when last heard of, had remained free from any return of the disease for fourteen years; the other for a somewhat shorter period. Both of the cases had persistently taken chaulmoogra oil—a fact which may be taken for what it is worth; one remained in England, and the other in a healthy part of India. The writer has used chaulmoogra oil internally in a considerable number of cases, and with apparent benefit in most, if not all. The oil appears to be more easily borne by lepers than by other people; but, in order to produce any marked effect, the treatment must be continued for years. He is strongly impressed with the belief that the application of external remedies produces no permanent good result, although it may temporarily relieve some of the symptoms. Of the many other drugs that he has tried, Gurjun oil and quinine are the only ones that have apparently done good, the latter probably only as a suitable tonic. From the comparative rarity of leprosy in this country, it is very difficult to obtain a sufficient number of cases on which to base our conclusions as to the effect of treatment, and therefore the results of any experiments in the use of drugs must be received with caution. There is another fact which must be taken into consideration, namely, that leprosy is liable—at least in healthy climates—to long periods of comparative rest or subsidence, quite apart from any special treatment. It is, in short, one of the features of the disease that it does not progress uniformly. Sometimes it appears for a time as if cured, and then breaks out again without any apparent exciting cause. It is very necessary to bear these facts in mind, because those who are unacquainted with the peculiarities of the disease are apt to attribute to remedies what really is the natural course of the malady, under the influence of a mild and healthy climate.

In the later stages of the disease, it is well to bear in mind that those who dress the open sores of lepers should be careful not to allow the discharge to get into any cuts or wounds in their hands. Scrupulous cleanliness and disinfecting dressings are also advisable.

With regard to the segregation of lepers in those countries where the disease is endemic, it is highly desirable that leper-hospitals should be provided, and the lepers encouraged as much as possible to enter them. This would not only be an advantage to the lepers themselves, but of even greater benefit to the community at large.

Robert Liveing.

LEPTOMENINGITIS (λεπτός, delicate or thin; and *meningitis*).—A term signifying inflammation of the pia mater. By its use, in association with arachnitis and pachymeningitis, we are enabled accurately to indicate the precise seat of inflammation involving the meninges of the brain or spinal cord. There is a practical convenience, warranted by pathological facts, in retaining the term 'arachnitis,' although anatomists are not now disposed, as they were formerly, to believe in the existence of an arachnoid membrane, distinct externally from the dura mater, and internally from the pia mater. *See* Meninges, Diseases of.

LEPTOTHRIX (λεπτός, delicate or slender; and θρίξ, a filament or hair).—*Leptothrix buccalis* is a name assigned by Robin to certain vegetable parasites or minute filaments, which can be recognised, by means of the microscope, amongst the epithelial scales of the tongue or other parts of the mouth; and especially between the teeth, or in the hollows of decayed teeth. They occur in healthy persons, as well as in the sick, and have in this situation really no pathological signification.

Dermatologists also employ the term 'leptothrix' to indicate a morbid thinness and weakness of the hair. *See* Lepothrix.

LESION (*lædo*, I hurt).—This word originally signified a hurt or an injury; but its use is now extended to comprehend all organic changes of a morbid character, affecting an organ or tissue.

LETHARGY (λήθη, oblivion; and ἀργία, idleness).—A disorder of consciousness, which consists of prolonged and profound sleep, from which the patient may be momentarily aroused, but into which he falls off again immediately. One form of it corresponds with the final stage of hypnotism. *See* Consciousness, Disorders of; and Trance.

LEUCE (λευκός, white).—This term has been applied to blotches in the skin of a white colour; and hence it has alternately been confounded with lepra alphoides, with vitiligo, and with the leucodermic blotches of leprosy. It, however, seems more than probable that the pathological condition intended to be signified by this word is a circumscribed scleriasis, namely, that which we at present term *morphœa alba*. *See* Scleroderma.

LEUCIN (λευκός, white).—Synon.: Fr. *Leucine*; Ger. *Leucin*.

Leucin or amido-caproic acid is a decomposition-product of the complex proteid molecules, when these are acted upon by strong acids or alkalis, or when they are submitted to the prolonged action of the pancreatic ferment trypsin. Its chemical composition is represented by the formula $C_6H_{13}NO_2$, thus showing it to be a compound of ammonia with a fatty acid. It is a product of intestinal digestion, but does not occur normally in the fæces or urine.

As the internal administration of leucin increases the amount of urea excreted, physiologists now regard it as an antecedent of urea in the decomposition of proteids; the transformation in all probability occurring in the liver.

Characters.—Pure leucin is soluble in water, slightly in alcohol, insoluble in ether.

Microscopically, leucin, as it occurs in the urine, appears as oil-like, highly refracting, laminated, crystalline, globular masses, obscurely radiating; but, when pure, leucin forms white, glistening, flat crystals (fig. 66). The microscopic test is not a thoroughly reliable one, hence we must have recourse to the following method: Free the urine of

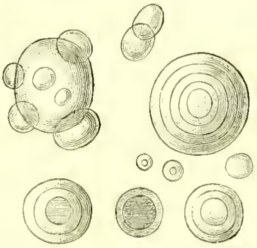

Fig. 66.—Crystals of Leucin. × 200.

albuminous substances, and precipitate it with basic lead acetate; filter, and pass sulphuretted hydrogen gas through the filtrate to remove the excess of lead; filter, and evaporate the filtrate to dryness. Extract the residue with boiling alcohol; filter, and evaporate the filtrate to a syrupy consistence, when, if present, leucin will crystallise out.

Chemically, leucin is to be detected by the following characteristic reaction: A little urine mixed with nitric acid is carefully evaporated to dryness on a platinum foil; a nearly imperceptible colourless residue is left. If caustic soda is added to this residue, and heat applied, the leucin will be dissolved, and according to its degree of purity the solution thus formed will be either colourless or of a yellowish-brown colour; and on concentrating the fluid by heat on platinum foil, an oily drop is formed, which rolls about on the platinum foil.

Pathological Significance. — Leucin is a constituent of many organs of the body, more especially of the glandular tissues. It is found in the liver, kidneys, pancreas, the thymus, thyroid, salivary, and lymphatic glands, and in the brain. Leucin and tyrosin have been detected in the urine only in cases of acute yellow atrophy of the liver, and in the atrophied hepatic cells in the same disease (*see* Liver, Atrophy of, Acute Yellow). Tyrosin is invariably found associated with leucin. *See* Tyrosin.

John Harold.

LEUCOCYTHÆMIA (λευκός, white; κύτος, a cell; and αἷμα, blood).—Synon.: *Leukæmia* (Virchow); *Splenopathia leucocythæmia* (Huss); Fr. *Leucocythémie*; *Diathèse lymphogène à forme leucémique* (Jaccoud); Ger. *Leucocythämie*.

Definition.—A chronic disease, in which there is a considerable and permanent increase in the number of the pale blood-corpuscles; usually associated with enlargement of the spleen, sometimes also with that of the lymphatic glands, and with disease of the medulla of bone.

The term 'leucocythæmia,' proposed by the late Dr. Hughes Bennett, is a convenient and significant designation, the essential feature of the disease being the excessive proportion of leucocytes in the blood. The shorter word 'leukæmia,' proposed by Virchow, and much used, is less obviously accurate, since the blood (as Parkes urged), although appreciably paler than normal, is not white.

Excess of leucocytes in the blood, slight or transient, is known as 'leucocytosis,' and is met with in many morbid states. Permanent excess, sometimes considerable, but rarely very great, also occurs, associated with a primary enlargement of the lymphatic glands —'lymphatic leucocythæmia.' These cases differ in many important respects from the cases of leucocythæmia associated with primary enlargement of the spleen; so that it is most convenient to describe them in connexion with lymphadenoma, and to consider here only cases of splenic leucocythæmia. *See* Lymphadenoma.

History.—Pallor of the blood, as if pus were mixed with it, was noted by Bichat in the beginning of this century; and the combination of this appearance with enlargement of the spleen was observed by Velpeau in 1827. The dependence of this alteration in the blood on an excess of pale corpuscles was described by Donné in 1844, and interpreted by him as due to imperfect transformation of white into red corpuscles. In 1845, two cases of the disease were published together, the one by Dr. Craigie, the other by Dr. Hughes Bennett; and to the latter appears to belong the credit of recognising the salient features of the affection as a distinct malady. A month later, however, Virchow published another case, independently and admirably worked out. In all these cases the change in the blood was only recognised after death. It was first observed during life in 1846, by Dr. H. W. Fuller, and subsequently by Dr. Walshe. In Germany the first case was diagnosed during life, by Vogel, in 1848. Since then numerous cases and descriptions of the disease have been published, of which the more important are those of Virchow, Hughes Bennett, Vidal, Huss, Ehrlich, and Mosler.

Ætiology.—In only a small proportion of cases of leucocythæmia can any causation be traced. Race, as such, seems to be without influence. Heredity has only been traced, as a history of splenic disease in ancestors or collaterals, in one or two isolated instances. The disease is twice as frequent in men as in women. It may occur at all ages. It is very rare under the age of ten, and the numbers gradually rise, taking both sexes, to the decade between thirty and forty, when nearly one-third of the total occur (46 out of 154 cases). After forty they fall in each decennial period. In females, however, the maximum is reached in the period between forty and fifty; and of eleven cases over sixty collected by Dr. Gowers, only one was in a woman. Position in life appears to exercise no influence on the occurrence of the disease. Depressing influences, inanition, over-exertion, and especially depressing mental emotion, are antecedents which have been occasionally noted. Sexual processes, in women, appear to have a distinct influence. The disease has been seen to be most frequent, in them, during the climacteric decade, and practically to cease when the menstrual epoch is over. In some cases the disease has commenced during pregnancy; in a larger number it has succeeded parturition. Injury to the spleen seemed, in one or two recorded cases, to be the cause of the disease. Small-pox, typhoid fever, acute rheumatism, pneumonia, and syphilis have been supposed to be causes of the affection, but the ætiological relation is doubtful. Of all antecedent conditions, intermittent fever is incomparably the most frequent. In one-fourth of the total number of cases (150) analysed by Dr. Gowers, there was a history either of ague or of residence in an ague district. The interval between the malarial affections and the disease varied from a few months to thirty years. The fact that, in many cases, a long period elapsed, and that the attacks of ague, in some instances, were trifling, makes it probable that, in the cases in which the patients had merely lived in an ague district, the malarial influence, which did not cause ague, led to morbid changes which eventuated in the leucocythæmia. One patient under Dr. Gowers's care, a middle-aged woman, had lived in a malarial district only during the first few years of her life, but, shortly before her birth, her mother had suffered from an attack of ague.

Anatomical Characters.—*Blood.*—The blood, as seen after death or during life, is paler than normal, and may even be greyish-red in colour. In extreme cases coagulation is imperfect; a grumous chocolate-brown mass results. After defibrination three layers form—red corpuscles, pale corpuscles, and serum. Under the microscope the pale corpuscles are seen to be in great excess; instead of two or three per field, as in the normal, there may be several hundreds. Enumeration (*see* Hæmacytometer) shows that not only are the white corpuscles increased, but the red are lessened out of proportion to the increase in the white, so that the total number of corpuscles is always diminished. Instead of the normal 5,000,000 per cubic millimeter, there may be only 2,500,000 or even 1,150,000 (50 and 23 per cent. of the normal). The proportion between the white and red varies, being 1–20, 1–10, 1–5, 1–2, or 1–1; or the white may be the more numerous. The apparent is greater than the real excess of white, in consequence of the closer contact of the red. It was proposed by Magnus Huss to regard as leucocythæmia only those cases in which the proportion is greater than 1 to 20, and the rule has been largely followed; but it must be remembered that in commencing cases the proportion may be smaller than this. The greatest change hitherto recorded was a reduction of the red from 5,000,000 to 470,000 per cubic millimeter (9 per cent. of the normal), and an increase of the white to 680,000 per cubic millimeter instead of 15,000, the normal average. The pale corpuscles may be of normal size; but usually some are large, and often many are smaller than normal (the *globulins* of Donné), especially when the lymphatic glands are affected. Reagents bring into view one to four nuclei. Some of the corpuscles present obvious fatty degeneration. The red corpuscles are either normal in appearance, or present great variety in shape and size (*poikilocytosis*). They are sometimes unduly pale. Nucleated coloured corpuscles have been seen in a few cases, believed to be intermediate forms between the white and red corpuscles. The amount of hæmoglobin is less than that which corresponds to the number of red corpuscles present. The specific gravity of the blood is lessened from 1,055, the mean in health, to an average of 1,042; the change being due to an increased proportion of water, from 790 parts per 1,000 in health to 840 in leucocythæmia. The fat and fibrin are increased, and the latter sometimes presents a peculiar granular appearance. The iron is lessened. Abnormal constituents have also been found in the blood, such as the albukalin of Reichardt, mucin, a substance analogous to glutin, hypoxanthin, lactic and formic acids. Minute octahedral crystals have been found in the blood and in many organs after death, about ·016 mm. in length. Their nature is uncertain. Since they have been found only after death, it is conjectured that the substance of which they consist is held dissolved during life. They are not peculiar to this disease.

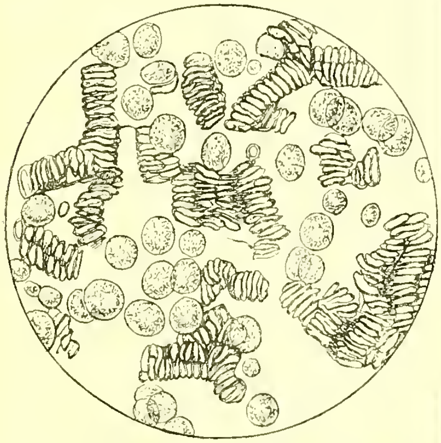
Fig. 67.—Blood in Leucocythæmia. × 600.

Organs.—The *spleen* is always enlarged, sometimes extremely. Its weight varies from twice to fifty times the normal—1 lb. to 18 lbs. The average of 72 cases analysed was about 6 lbs. The average length is nearly 12 inches. The enlargement is commonly uniform; the shape of the organ being preserved. The surface is smooth, but often presents traces of local peritonitis, in the form of yellowish opaque patches. It is frequently adherent to the diaphragm, omentum, abdominal wall, intestines, or liver. Its consistence is usually increased, rarely diminished. The cut surface is smooth, and yields comparatively little blood; it is brownish-red, or even brownish-yellow, marbled with paler lines, due to thickened trabeculæ. The Malpighian follicles are not usually conspicuous. In cases which begin with enlargement of the lymphatic glands, and which are really cases of primary lymphadenoma, the Malpighian follicles may be so enlarged as to constitute small growths. There is rarely an area of distinct softening. Wedge-shaped, yellowish-white, caseous portions are frequent, and are evidently infarcts; when recent they are deep red. The histological change in the organ is an overgrowth of the splenic pulp; the trabecular tissue is increased; and so also is the retiform tissue of nucleated fibres and cells, among which the lymphoid corpuscles lie. The Malpighian bodies may not be discoverable with the microscope, or they may be found to have undergone fatty or lardaceous degeneration. The infarct-like masses present the splenic tissue-elements in a state of fatty degeneration. In many cases the crystals, already described, have been found in the spleen in great abundance. This organ has been found by analysis to contain glutin, glycocoll, hypoxanthin, xanthin, leucin, and tyrosin.

The *lymphatic glands*, some or many, are enlarged in one-third of the cases of primarily splenic leucocythæmia (51 out of 157 cases). The order in which the several groups are affected is, beginning with the most frequent, the mesenteric, cervical, inguinal, axillary, retro-peritoneal, thoracic, portal, and iliac. In only five cases was the change universal. The enlargement is not considerable, the individual glands rarely attaining the size of a walnut. They are usually smooth, soft, grey, or reddish-white on section; rarely caseating or suppurating; sometimes presenting hæmorrhagic extravasations. Their minute structure differs little from the normal. Lymphoid corpuscles lie in an adenoid reticulum, which is rarely increased, as it is in lymphadenoma.

With respect to the *alimentary canal*, the gums are occasionally swollen and ulcerated, the swelling being due to infiltration of the gum with leucocytes, or to an actual lymphoid growth. The tonsils and follicles of the tongue are sometimes enlarged by lymphoid growth; and there may be a similar change, usually slight, in the lymphoid tissue of the wall of the stomach, and much more considerable in the solitary and agminated glands of the small intestine. These growths frequently ulcerate. Similar changes are also found in the large intestine. The *peritoneum* sometimes presents similar growths. The *liver* is enlarged in at least two-thirds of the cases, varying in weight from 5 lbs. to 14 lbs. In some cases of slight enlargement no structural change beyond congestion has been found; frequently, however, there are disseminated lymphoid growths, minute, greyish-white, commonly interlobular in position, often surrounding branches of the portal vein. The capillaries are always distended with pale corpuscles. Fatty degeneration of the liver-cells is also common. The *kidneys* are abnormal in at least one-half of the cases. They may be simply pale, from anæmia; pale and enlarged, from granular degeneration of the cells and distension of the capillaries with leucocytes; or they may present minute growths similar to those in the liver, and situated between the tubuli of the cortex, especially near the glomeruli. Marked fatty degeneration of the kidney has also been found. The *suprarenal bodies* have been found diseased in several cases, and in one or two there was bronzing of the skin. The *thymus* and *thyroid* glands have also been found enlarged. The *heart*, as in other cases of intense anæmia, may present granular and fatty degeneration. Extravasations of blood have been found beneath the endo- and pericardium. The capillaries of the heart are often distended with leucocytes. Pericardial effusion is common. The *lungs* may present simply distension of capillaries, or hæmorrhagic infarcts, or actual growths, similar in structure to those found elsewhere. These commence at the bronchi and infiltrate adjacent tissues. Rarely they may break down and form cavities. Pleural effusion is very common, and lymphoid growths have been found on the membrane. In the *brain*, hæmorrhages, usually multiple, constitute the most frequent change. Minute growths in the membranes, distension of the meningeal vessels with pale blood, and their obstruction by masses of leucocytes (Bastian), have also been recorded. The *skin* is, in rare cases, the seat of growths. The *bones* have been found diseased in many cases (Ranvier, Neumann, &c.) The marrow is grey or reddish-grey, diffluent, presenting lymphoid cells and blood-corpuscles. Sometimes cells intermediate between white and red corpuscles have been found in it. The vessels are fewer than normal. The change may be found in all the bones, most marked in those which possess most spongy tissue, as the ribs and vertebræ, but also considerable in the long bones. Externally the bones may be normal or enlarged. The compact substance may be reduced in thickness, and even perforated (Mosler). The *retina* is frequently diseased. Hæmorrhages may be found, especially in the nerve-fibre layers, and adjacent to them the retinal elements may be degenerated. The capillary vessels are filled with pale corpuscles, and actual lymphoid growths have also been found.

SYMPTOMS.—Of the early symptoms of leucocythæmia, the most frequent are those due to the splenic enlargement, namely, abdominal fulness, pain, or an actual tumour. Next in frequency is weakness. Hæmorrhage, especially epistaxis, often occurs early, but rarely before other indications of ill-health.

The change in the blood causes pallor of skin and mucous membranes, shortness of breath, and all the indications of anæmia. But in many cases the face retains a good colour for some time in spite of marked excess of white corpuscles. The altered characters of the blood, readily observable during life, have been already described. The temperature is frequently, but not invariably, raised. It is commonly higher in the evening than in the morning; the evening rise usually reaching 101°–104° F. The morning fall may be considerable or slight. Sometimes periods of considerable pyrexia alternate with others in which there is little fever. The cases in which there is most pyrexia are usually, but not always, those of most rapid course. The enlargement of the spleen presents the typical characters of a splenic tumour. It may occupy the whole left half of the abdomen, extend even beyond the middle line, descend into the iliac fossa, and even into the pelvis, so as to be perceptible by vaginal examination (Spencer Wells). It may vary in size from time to time. Friction may sometimes, and a *bruit de souffle* rarely, be heard over it. It usually causes an unpleasant sense of distension, is often tender, and sometimes is the seat of spontaneous pain. By its pressure it may raise the heart, cause considerable dyspnœa, and interfere greatly with the functions of the stomach. The distension of the abdominal wall may cause lines, similar to those of pregnancy, to appear over the spleen, and their position is sometimes distinctly determined by the course of vessels. The enlargement of the glands is rarely sufficient to give rise to other symptoms than the obtrusive evidence of their presence. The glands thus present, in this disease, a marked contrast to their condition in lymphadenoma. They often lessen in size before death. The alteration in the bones is usually unattended by symptoms. Rarely they become distinctly enlarged and tender. The action of the heart is disturbed by both the anæmia and the displacement. The pulse is frequent; and palpitation is common. The circulation is impeded; effusion of serum into the cellular tissue of the body is almost invariable in the later stages of the disease. Slight ascites is frequent, and great effusion is sometimes due to the pressure of enlarged glands on the portal vein. Hydrothorax is also common. The most striking circulatory symptom is hæmorrhage, which occurs in a large proportion of cases, most frequently from the nose, and less frequently from the bowels, stomach, lungs, uterus, into the skin, brain, joints, cellular tissue, or peritoneum. The hæmorrhagic tendency is so great that slight injuries may give rise to serious loss of blood; the extraction of a tooth, or the puncture for paracentesis, has thus led to death; while most cases in which excision of the spleen has been attempted have been fatal from the same cause. The respiration is usually interfered with, partly from the splenic enlargement, and partly from the anæmia; that due to the former is increased by the recumbent posture. The anæmic dyspnœa may be unnoticed when the patient is at rest, although any considerable movement causes an agony of breathlessness. The dyspnœa is also increased by changes in the lung, bronchial catarrh, and the frequent pleural effusion in the later stages. Cough is frequent, and may be an early symptom of the disease. The change in the gums, already described, may lead to ulceration—the 'leukæmic stomatitis' of Mosler; but it is more rare in this disease than in lymphadenoma. The gastric functions are chiefly interfered with by the pressure of the spleen, which causes dyspepsia, and often vomiting. Diarrhœa is extremely common, and may be accompanied by hæmorrhage. The enlargement of the liver may be recognised during life, but rarely gives rise to subjective symptoms. Jaundice only results from compression of the bile-ducts by enlarged glands. A yellowish tint of skin is, it may be remarked, frequent, apart from true jaundice—the 'icterus lienalis'; it probably results from the anæmia, the altered blood being unable to destroy the bile-pigment absorbed into it from the intestine. The urine varies in amount, but is usually strongly acid, and of high specific gravity. The amount of urea is unaltered, that of uric acid is increased. Hypoxanthin, lactic acid, and formic acid have been found in it. Albumen is rare, apart from structural changes in the kidneys. Menstruation is usually arrested. The functions of the nervous system are disturbed by the altered blood: languor, tinnitus, and vertigo are frequent; and slight mental failure, delirium, and coma are occasionally met with. The graver symptoms are probably due to capillary obstruction by masses of leucocytes, or to small hæmorrhages. Besides the noises in the ears, deafness is common, especially towards the end. In the fundus oculi changes may usually be seen with the ophthalmoscope. The pallor of the blood in the retinal and choroidal vessels is conspicuous. The retinal veins become very broad, and are often tortuous. Extravasations of blood are almost invariable at some period, usually striated, sometimes rounded. Yellowish or white spots are sometimes seen, due to the collections of lymphoid cells already described. Occasionally the retina is irregularly thickened, so that the vessels present conspicuous antero-posterior curves. These changes constitute the 'leukæmic retinitis' of Liebreich. The extent to which sight is interfered with depends on the degree to which the neighbourhood of the macula lutea is involved. The skin is strikingly pale, or sometimes, as already stated, greenish yellow. Occasionally a peculiar dark pigmentation is present. Sweating is common.

COMPLICATIONS.—The most frequent complications of leucocythæmia are pleural effusion, œdema of the lungs, lobar pneumonia, bronchial catarrh, pericardial effusion, dilatation of the heart, venous thrombosis, cerebral hæmorrhage, and fatty degenerations. The more rare complications are cirrhosis of the liver; parenchymatous degeneration of the kidneys, giving rise to the symptoms of subacute Bright's disease; renal calculi; persistent or intermittent erection of the penis, the former probably due to thrombosis in the corpora cavernosa; œdema of depending parts; ascites; furuncles; and erysipelas. The various hæmorrhages are rather to be regarded as symptoms of the disease than as complications.

DURATION.—Cases of splenic leucocythæmia vary in duration from six months to seven years. One or two recorded cases ran their course in less than six months. The average duration of sixty-three cases was two years. The actual duration of the affection is probably longer than this, because the disease has often reached a considerable degree before the symptoms become troublesome.

CAUSES OF DEATH.—The most common causes of death in leucocythæmia are loss of blood, asthenia, diarrhœa, cerebral hæmorrhage, pneumonia, and pleurisy. In asthenia the actual end is often due to cardiac failure. The hæmorrhage most frequently fatal is from the nose, the next most frequent from the bowels.

PATHOLOGY.—The pathology of leucocythæmia is still involved in obscurity. We are imperfectly acquainted with the normal life-history of the blood-corpuscles. For a full discussion of the facts which have been ascertained, and the theories built upon them, the reader is referred to Dr. Gowers's article on the disease in Reynolds's *System of Medicine*, vol. v. It is only possible here to give a brief outline of the pathology of the disease which these facts and theories suggest. Recent researches make it probable that the red corpuscles arise from a transformation of the smaller lymphoid cells—*globulins* of Donné, hæmatoblasts of Hayem; and that this transformation takes place to a large extent in the splenic pulp and in the marrow of bones, tissues which have many histological characters in common. If these tissues are diseased, the transformation may not take place, and the unchanged lymphoid cells may develop into the ordinary leucocytes, which are either retained in these tissues, increasing their bulk and changing their structure still further, or pass into the blood. Both results probably occur. Hence we assume a primary change of the splenic pulp, which is increased further by the retained leucocytes. Where the hæmatoblasts arise is still uncertain. They are probably in part developed in the splenic pulp and marrow of bones, from pre-existing cells, and from the protoplasmic trabeculæ of the tissues (Klein); probably in part they come from the true lymphatic structures, the glands, Malpighian follicles of the spleen, &c. Primary disease of these lymphatic structures constitutes lymphadenoma; and the splenic pulp may be normal, and the leucocytes are only in slight excess, or are not more numerous than they should be. In true splenic leucocythæmia, the glands and Malpighian follicles are not primarily diseased, but they may suffer secondarily, when lymphatic growths arise in organs; and this secondary affection is in part the result of the accumulation of leucocytes. That the enlargement of the spleen is not, as has been thought, merely the result of the accumulation in it of pale corpuscles from primarily diseased blood, is shown by the increased consistence of the organ, and by the fact that the splenic tumour precedes the change in the blood. There is some reason to believe that, as the spleen alone may be diseased, so, in some rare cases, the marrow of bones may alone be diseased, and may give rise to a primary 'myelogenic leucocythæmia,' but this is not yet proved. That the disease may be primary in both the marrow and the spleen is highly probable from recorded facts. It is certain, however, that the marrow is, in most cases, not affected primarily, and may be unaffected throughout, or may suffer secondarily, as do the glands. The same is true of the collections of lymphatic tissue elsewhere in the body. The cases in which the lymphatic glands enlarge early—'lymphatico-splenic leucocythæmia'—are, for the most part, if not entirely, cases of composite nature. The spleen presents a double change—growths in the follicles, such as are associated with the glandular growths in lymphadenoma (Hodgkin's disease), and increase in the splenic pulp, as in pure splenic leucocythæmia. In such cases there may be a large increase in the pale corpuscles of the blood.

DIAGNOSIS.—The diagnosis of leucocythæmia rests on the existence of enlargement of the spleen, and a considerable excess of leucocytes in the blood. In all cases of splenic tumour the blood should be examined: if the proportion of white corpuscles to the red is greater than 1 to 20, the case is certainly one of leucocythæmia. But if the proportion is less than this, leucocythæmia cannot with certainty be excluded, because it is probable that, in all cases, the splenic tumour precedes the leucocytal excess, and the latter may be in process of development. To ascertain the actual state of the blood, it is always desirable to enumerate the corpuscles with the hæmacytometer. Repeated examination, to ascertain that the proportion of pale corpuscles is not increasing, is necessary before impending leucocythæmia can be excluded. In cases in which the lymphatic glands enlarge early, the question arises whether the case is one of splenic leucocythæmia, or of Hodgkin's disease. In the latter, as just stated, the enlargement of the spleen depends, not on an increase of the splenic pulp, but on overgrowth of the Malpighian follicles; the splenic enlargement is less than in leucocythæmia, and is less uniform. In the composite cases alluded to above, in which, with enlargement of the glands and splenic follicles (lymphadenoma), there exists also overgrowth of the splenic pulp, and a considerable leucocytal excess in the blood, the two morbid processes are conjoined, and the affection may be termed lymphadeno-splenic leucocythæmia. These cases are distinguished from the simple splenic affection by the early enlargement and firmness of the glands. In simple splenic leucocythæmia the affection of the glands is usually late, and rarely considerable. The diagnosis of the disease from conditions in which a considerable excess of pale corpuscles exists, without enlargement of the spleen, is usually easy, because such excess is transient, soon passes away, and is not associated with a splenic tumour.

Prognosis. — The prognosis of a disease which depends on a primary affection of the blood-forming organs is necessarily most grave. No means of arresting the progress of the developed disease has yet been discovered. The immediate prognosis is less serious in proportion as the evidence of organic changes in the blood-forming organs is slight, and in proportion to the early stage of the disease. Neither age, sex, nor causation affords prognostic information. The greater the number of white corpuscles and the deficiency of red, as ascertained by counting, the worse the prognosis. The size of the spleen, alone, affords little information. Hæmorrhages are of grave augury, but epistaxis least so.

Treatment.—The knowledge of the causes of leucocythæmia, slight though it is, suggests important prophylactic measures—the prevention of ague, and the careful treatment of all who have been exposed to malarial influences. Splenic tumours resulting from such exposure should be systematically treated; the subjects of them should exercise great care to avoid exposure to cold, injuries, and all causes of portal congestion. These precautions are especially necessary in women at the menstrual periods; and if such women bear children, their state during pregnancy and after parturition should be carefully supervised, and lactation prohibited. Whether there is simple anæmia or leucocythæmia, every effort should be made to reduce the size of the splenic tumour, by quinine, cold affusion, ergotin, and especially by voltaic electricity, a most powerful agent. By obtaining contraction of the spleen, expelling retained leucocytes, and perhaps stimulating directly its functional action, we render its condition less abnormal. In a case of anæmia splenica no remedies improved the blood-state till the spleen was galvanised, when the red corpuscles at once began to increase. Remedies which do good in ordinary anæmia have slight influence in this disease. Iron is almost useless; cod-liver oil, however, has seemed to do some good. Arsenic has been largely tried, but without benefit in pronounced cases. Its undoubted value in lymphadenoma suggests its further trial in early cases; it should be given in the largest doses that can be borne. Mosler advises injection of Fowler's solution into the spleen; provided that the organ is firm, dense, and close to the abdominal wall, that there is no hæmorrhagic tendency, and no high degree of cachexia. Phosphorus has been recommended, but in almost every case of pronounced leucocythæmia it has been powerless for good. Nevertheless, its influence in improving the blood-state in lymphadenoma warrants further trial in the early stage of the disease. Iodides, bromides, and mercury are useless Temporary improvement has been obtained by the inhalation of oxygen to the extent of 30 litres daily (Kirnberger). Change of air may slightly improve the patient's state, but has no influence on the disease. Transfusion has been tried, but the results are not encouraging. Excision of the spleen has been attempted. The operation has been performed with success in cases of anæmia splenica, but in actual leucocythæmia it has been invariably fatal—in most cases from uncontrollable loss of blood, the result of the hæmorrhagic tendency. Further trial of it, in such cases, does not seem to be justifiable. In early cases, where there is no considerable excess of pale corpuscles, and the red are not reduced below 60 per cent. of the normal, it might be successful; but it is questionable whether, in these cases, an ultimate bad issue without interference is sufficiently certain to justify the performance of so grave an operation. Special symptoms may require treatment. Hæmorrhage must be checked by the usual methods, and crystals of perchloride of iron may be applied to accessible places (Jenner). For vomiting, a posture which will relieve the stomach from pressure, and counter-irritation, are useful. Aperients should be employed with caution; and under no circumstances should the yellow tint of the skin lead to the use of mercurials. For the œdema, digitalis and other diuretics are best. For the splenic pain, counter-irritation, sedative liniments, and hypodermic injections of morphine may be used. In proportion to the anæmia, physical rest is important, that the diminished supply of oxygen may not be rendered inadequate for the need of the tissues, by muscular exertion.

W. R. Gowers. Frederick Taylor.

LEUCOCYTOSIS (λευκός, white; and κύτος, a cell).—A condition of the blood, in which the white corpuscles are appreciably but moderately increased. *See* BLOOD, Morbid Conditions of; and LEUCOCYTHÆMIA.

LEUCODERMA (λευκός, white; and δέρμα, the skin).—White or achromatous integument. *See* PIGMENTARY DISEASES OF THE SKIN; and LEUCOPATHIA.

LEUCOMA (λευκός, white).—A white opacity of the cornea, generally referable to inflammation or ulceration of that structure. *See* EYE, AND ITS APPENDAGES, Diseases of.

LEUCOMAÏNES (λεύκωμα, whiteness). A term applied to a class of alkaloids resulting from the normal metabolism of the animal proteid tissues without the intervention of any bacterial agency. To the class of alkaloids resulting from the putrefaction of tissue the term *ptomaïnes* is given. *See* PTOMAÏNES.

LEUCOPATHIA (λευκός, white; and πάθος, a disease).—SYNON.: Albinism, Achroma, Leucoderma, Leuce, Leucasmus.

This disease is sometimes general, but frequently partial; in the latter form constituting *cutis variegata* and 'piebald skin.' The whiteness is referable to absence of pigment, which may be simply due to an arrest of function of the rete mucosum, or to an organic alteration of the integument. *See* PIGMENTARY SKIN-DISEASES.

LEUCO - PHLEGMATIC TEMPERAMENT.—*See* TEMPERAMENT.

LEUCOPLAKIA BUCCALIS ET LINGUALIS.—*See* TONGUE, Diseases of.

LEUCORRHŒA (λευκός, white; and ῥέω, I flow).—SYNON.: Fr. *Leucorrhée*; Ger. *Weisser Fluss*; Lat. *Fluor Albus*; Pop. 'The Whites'; 'White Discharge.'

DEFINITION. — A non-hæmorrhagic discharge, of pale colour, escaping from the female genital fissure.

ÆTIOLOGY.—Leucorrhœa is a symptom rather than a distinct disease; and may result from any of the morbid processes that lead to hypersecretion from the genital mucous surfaces, or from the glands opening upon them, whether the mucous membranes be injured or entire. It is, however, a source of much discomfort and deterioration of health, and so demands special treatment.

SYMPTOMS.—Leucorrhœa presents several distinct varieties according to the seat of its cause; and the symptoms of each variety require separate consideration.

1. **Vulvar Leucorrhœa.**—In this variety a glairy viscid secretion is found bathing the apposed surfaces of the pudenda, stiffening into a crust on the surface of the labia majora or on the insides of the thighs, and sometimes glueing the lips more or less firmly together at their margins. It is usually derived from the muciparous glands covering the internal surfaces of the labia majora and the nymphæ; but in cases of special eruptions and general vulvitis it may come from the vestibular surface; and in still rarer cases it is poured out from the glands of Bartholin. Vulvar leucorrhœa is met with at any period of life, but is most common in the young, *infantile leucorrhœa* almost always being of this variety. In cases of gonorrhœal infection in the female, the vulva is usually the seat of a profuse discharge which is apt to become purulent, but it is rarely confined to this situation, spreading both into the urethra, and upwards into the higher spheres of the genital mucosa.

2. **Vaginal Leucorrhœa.**—The discharge in cases of vaginal leucorrhœa is most frequently white in appearance, of acid reaction, and due to a secretion from the general surface of the vaginal mucous membrane. Its whiteness is found, on microscopic examination, to be owing to the presence of quantities of scaly epithelial cells, many of which are crowded with fatty particles, whilst others have been quite dissolved in consequence of the fatty degeneration. Sometimes the discharge has a more yellowish tint, and then it is found to contain quantities of pus-cells among the epithelial scales. In the former group of cases we have to do with a simple catarrhal condition of the vaginal mucosa: in the latter there are red granulation-like spots scattered over the membrane, which has here lost its epithelial covering. Vaginal leucorrhœa is a complaint to which women are specially liable during their reproductive life. The catarrhal form is extremely common in young married females; whilst the other form occurs rather about the menopause, or, if occurring earlier, is complicated with some of the other varieties of leucorrhœa. Apart from specific causes, it may be brought on by sexual excesses; by the presence of a foreign body, such as a pessary; by a displaced uterus; by a chill; or by any condition that interferes with the circulation in the pelvis. In a large proportion of cases it is secondary to the next variety of leucorrhœa.

3. **Cervical Leucorrhœa.**—The discharge that comes from the canal of the cervix uteri is transparent, like unboiled white of egg, very tenacious, and of alkaline reaction. It may still present these characters as it escapes from the pudenda; but it generally becomes somewhat clouded as it passes through the vaginal canal, and gets acted upon by the acid secretion from the vaginal walls. Independently of this change in the vagina, it is sometimes found already

more or less opaque as it lies within the cervical canal, and may be seen of a yellowish or greenish or reddish tint in various cases. The clear cervical leucorrhœa is seen under the microscope to be made up of a viscid magma, having entangled in it large numbers of columnar epithelial cells, which have a tendency to arrange themselves in rows. These are easily seen to be the ciliated epithelial cells that cover the normal mucous membrane, but deprived for the most part of their cilia. They are accompanied by smaller rounded cells like mucous corpuscles or wandering cells, partly derived from the interior of the crypts, and partly shed from the general surface from which the epithelium has been removed. In almost all cases some of the epithelial cells and mucous corpuscles are charged with fatty particles, and surrounded with granules, resulting from the breaking down of some of their number. The more turbid the fluid, the more the cells are found to have undergone such degeneration; and where the discharge is profuse, fluid, and of yellowish colour, it has more the characters of a purulent fluid in which the relatively few cylindrical cells are changed in form, becoming oval or rounded, and nearly all reduced to a compound granular mass. The more deeply tinted discharges owe their discoloration to the admixture of blood, the red corpuscles of which can easily be recognised. Apart from the leucorrhœas of specific origin, this is the commonest of all the varieties. It may be found in females of any age, but specially affects women during their reproductive history, and more especially those who have been mothers. We can understand the special liability of the cervix to catarrhal affections, when we remember that all intra-uterine discharges pass through and may irritate it; that it is exposed to damage during the transit of the fœtus in parturition; that vaginal affections easily pass into it by continuity of structure; and that it may readily be injured by foreign bodies in the vaginal canal, or even by fretting of its orifice against the vaginal wall in cases of displacement or excessive mobility.

4. **Intra-uterine Leucorrhœa.**—Here also the discharge is transparent, like white of egg, and alkaline in its reaction, but it is more fluid than the secretion from the cervical canal, and may escape as a clear liquid from the genital fissure. In cases of long standing, more particularly where there exists some organic disease in the uterine parietes, the fluid becomes turbid, purulent, and more frequently than in any other variety of leucorrhœa tinged with blood, even alternating with irregular discharges of blood. Under the microscope we see many cylindrical epithelial cells, not infrequently ciliated; along with groups of smaller cells, partly cylindrical, partly rounded, that have been discharged from the uterine follicles; all embedded in a mucous fluid. Where the discharge is more turbid, the epithelial cells are seen to be undergoing fatty degeneration, and to be accompanied with wandering cells, pus-globules, and crowds of free fatty particles. This uterine leucorrhœa may be found at any period of life, but as an independent affection it is found almost exclusively in virgins or young married women, or in women who are ceasing, or have ceased, to menstruate. In the last-named class of cases the cervix is often atrophied, and its orifices narrowed; and the intra-uterine secretion may accumulate for a time, and be expelled with some degree of suffering. Most frequently it is found associated with cervical leucorrhœa, the endo-cervical affection having passed up to the endometrium, or, more rarely, *vice versâ*. Perhaps the most frequent form of it is found in women who are subject to a leucorrhœal discharge before or after the menstrual periods; and in the cases of amenorrhœa where a pale discharge escapes at the usual menstrual periods, this has its source in the interior of the uterus proper.

5. **Tubal Leucorrhœa.** — Doubtless some small portion of the fluid that escapes in certain cases of leucorrhœa is furnished by the Fallopian tubes; but despite the elaborate attempts of Hennig and others to establish a distinction between it and the other varieties, it remains rather as a subject of pathological interest than of clinical importance, and need not occupy us further here.

Diagnosis.—The statements of a patient in regard to a leucorrhœal discharge cannot be relied on in establishing a diagnosis as to its source. If it be white and flaky we may judge that it is vaginal; if more transparent, and escaping in half-coagulated flocculi, we may conclude that it is cervical; whilst a clear and more continuous and fluid discharge would be more justly referred to the uterus proper. But it is never safe to trust merely to the appearance of the discharge as it escapes from the vulva, for it may have become modified as it lay in or traversed some part of the canal, or may be compounded of fluids derived from different surfaces. The seat of the discharge must therefore be exposed. In the vulvar variety it suffices to separate the labia and occasionally to expose the navicular fossa and the orifices of the Bartholinian ducts, by passing the finger into the anus. The vaginal form of leucorrhœa requires for its detection the use of a speculum, duck-bill or tubular; and the cervical, one of these or a bi-valve speculum. For the diagnosis of intra-uterine leucorrhœa it is sometimes helpful to remove some of the fluid for microscopic examination by means of a fine syringe. Unless a clear history of infection can be obtained, it is almost impossible to establish a distinction between a gonorrhœal discharge and the simpler catarrhal leucorrhœa. In the former there is a very notable tendency to spread through all the contiguous mucous surfaces, though the vulva may be predominantly affected. In children suffering from the infectious discharge, traces of the injuries that are usually inflicted at the period of infection should be sought for.

Treatment.—In instituting our treatment of leucorrhœa it is of the first importance to have in view the *constitutional* condition of the patient; to use means to counteract any diathetic tendency—tuberculous, strumous, or syphilitic; and to raise as far as possible the general standard of the patient's health, by the administration of tonics and the enforcement of a suitable diet and regimen. It is partly in this way that a change of residence is often useful; and in making a change, it is well for the patient to go to some of the spas, such as Ems or Kissingen, the waters of which are helpful in reducing congestions and catarrhs of the pelvic viscera. In young women of relaxed habit of body, it may be enough to prescribe quinine and iron or arsenic, and the daily use of a cold sponge bath; and in infantile leucorrhœa, cod-liver oil and iron should be administered.

In the great majority of cases of leucorrhœa some kind of *local* treatment becomes an absolute necessity. Sometimes it is enough to pay strict attention to cleanliness, washing the pudendal surfaces with a soft sponge, or syringing the vaginal canal with tepid water; and even when astringent applications are to be made, the surfaces should first be subjected to a detergent stream of water. Where there is marked congestion of the uterus it is best to make the injections with hot water, and to keep the stream passing through the vagina for at least five minutes at a time; the immediate relaxation of the blood-vessels and hyperæmia being followed by contraction of their walls, which favours the cessation of the discharge. The astringents most serviceable for checking *vulvar* and *vaginal* leucorrhœas are alum, aluminated iron, acetate of lead, sulphate of copper, sulphate of zinc, borax, and infusions of oak-bark, matico, and other vegetables charged with tannin. They are best applied in the form of an injection with a Higginson's syringe, having a vaginal nozzle attached to it; or of a douche through a long india-rubber tube, with a stop-cock for regulating the flow fitted close to the vaginal nozzle, and the other extremity opening into a wide receptacle, or fitted to a filler into which the fluid is poured. Where there is a difficulty in using the injection, and where it is desirable to keep up a more prolonged application of the medicament, it may be introduced into the vagina in the form of pessaries made with cacao-butter or with gelatine. Topical applications to the canal of the cervix and cavity of the uterus ought always to be made through the speculum, and without such applications it is a hopeless task to undertake the cure of *cervical* leucorrhœa. Here, more concentrated or more powerful astringents or escharotics become necessary. Nitrate of silver in the form of a stick of caustic is easily applied, but its repeated application may lead to mischief. Zinc-alum, dried sulphate of zinc, sulphate of copper, perchloride of iron, or tannin may be introduced, in the form of rods or arrows made with starch and gum. If a uterine sound or stilette be dipped in water and a thin film of cotton wadding wrapped round the point to the length of about two inches, the adherent mucus can be cleared away, and the same or another sound mounted with wadding can be charged with fuming nitric acid, the acid nitrate of mercury, strong carbolic acid, a solution of perchloride of iron, tincture of iodine, or iodised phenol, and carried through the speculum along the cervical canal. In *intra-uterine* leucorrhœa it becomes necessary to carry the application right up in the same way to the interior of the uterus. It is usually best to begin with one of the stronger liquids, apply it a few days after a menstrual period, and follow it up with applications of iodine. So long as the stilette or sound with the dry wadding passes easily through the os internum, it is usually necessary to continue from time to time the intra-uterine application.

Alexander Russell Simpson.

LEUKÆMIA.—*See* Leucocythæmia.

LEUTERBAD (Locite), **in Switzerland.** — Thermal earthy waters. *See* Mineral Waters.

LEVICO, in the Trientino, Austria. Arsenical sulphate of iron waters. *See* Mineral Waters.

LICE, Diseases Due to.—*See* Pediculus.

LICHEN (λειχήν, an eruption).—The somewhat loose definition given by the older writers to the word 'papule' caused them to include under the head of '*lichen*,' diseases, or rather conditions of the skin, some of which belong to other categories. Thus Willan's list included seven species: (1) *Lichen simplex*; (2) *L. pilaris*; (3) *L. circumscriptus*; (4) *L. agrius*; (5) *L. lividus*; (6) *L. tropicus*; and (7) *L. urticatus*.

1. **Lichen Simplex.**—This condition is merely a temporary lichenous condition—in short, the papular stage preceding the vesicular stage of eczema.

2. **Lichen Pilaris.**—Synon.: *Keratosis Pilaris*; *Pityriasis Pilaris*.—Lichen pilaris is an affection which is differently classed by authors; it is essentially a chronic condition, characterised by a heaping up of epidermis in horny papules round the hair-follicles, giving the part affected the feel of a rasp.

The papules are of the colour of the surrounding skin, which is generally ichthyotic or xerodermic; in fact, the condition keratosis pilaris is part of the general malformation of skin belonging to ichthyosis. The outer surfaces of the extremities and the backs of the hands and phalanges are the seats of election.

3. **Lichen Circumscriptus.**—Synon.: *L. Annulatus*, *Serpiginosus*; *Seborrhœa Corporis.*

Definition.—A serpiginous, ringed, papular eruption, occurring on the trunk, and accompanied by seborrhœa.

Description.—The sternal and interscapular regions are the seats of election, from which the eruption may spread to the epigastric or lumbar regions. The eruption is characterised by numerous circles and segments of circles (looking much like tinea). The margins of the circles are made up of minute red papules; the space enclosed is somewhat buff-coloured, and desquamating minute scales; the eruption has a greasy appearance, and is greasy to the touch. It is often associated with the wearing of flannel. The pathology is obscure, but some think its essential nature is that of a seborrhœa.

Treatment.—Any parasiticide ointment will remove it, such as creasote ten minims to one ounce of lard, rubbed in every night.

4. **Lichen Agrius.**—This, like lichen simplex, is apparently but a temporary stage of eczema.

5. **Lichen Lividus.**—Lichen lividus is a purpuric condition, in which the purpuric spots appear as papules round hair-follicles. *See* Purpura.

6. **Lichen Tropicus.**—Synon.: Prickly Heat.—This is a sudoral eruption due to inflammation of the sweat-glands. *See* Sudoriparous Glands, Disorders of.

7. **Lichen Urticatus.**—Lichen urticatus is an affection which is now classed as a variety of urticaria. It is common in children. *See* Urticaria.

In accordance with the teaching of Hebra, modern dermatologists are disposed to restrict the term 'lichen' to papular affections in which the papules retain their character as papules, and do not undergo any further evolution. There is another condition imposed, namely, that the papule must be inflammatory. The group 'Lichen' is thus narrowed down to two newly described diseases, *Lichen ruber* and *Lichen scrofulosorum.*

8. **Lichen Ruber.** — Synon.: *Lichen Planus.*

Definition.—A chronic eruption, more or less extensive, of flat and angular, or acuminate inflammatory papules, in colour either red or bluish-red.

Ætiology.—The disease may be due to nervous exhaustion, consequent on anxiety or any lowering influence, disorders of the stomach and intestines or uterus; in some cases possibly to chill. It generally attacks persons towards the middle period of life—twenty to fifty; but it may occur in the young.

Symptoms.—*L. ruber* or *L. ruber planus* (so named in contradistinction to the second variety, *L. ruber acuminatus*) commences as flat millet- or pea-sized papules, red or violet-red in colour. The lesions are discrete at first, but soon aggregate in patches or lines; if closely observed, a central depression (umbilication) is noticeable in the papules. As the patches enlarge, the appearance of individual papules becomes lost; the skin is thickened, raised above the surface, coarsely furrowed, and covered with minute goldbeater-skin-like scales. The seats of election are the wrists and forearms (flexor surfaces). No region is exempted. The eruption is often symmetrical, and it may be restricted to a certain nerve-distribution. Itching is almost a constant symptom, and may be intense. The disease may last for years, and ultimately become generalised. A single attack is the rule, but it may recur. The mucous membranes may be affected.

Lichen ruber acuminatus is the form originally described by Hebra as *lichen ruber.* It is more frequently general, and attended with severe symptoms, shivering, general aching, and profuse perspiration (Crocker). The papules are smaller and more conical than in the preceding variety; the whole process is more acute. The two forms of eruption may be present at the same time.

Pathology.—In the plane variety the process appears to be inflammatory, associated with the sweat-ducts at first, with subsequent thickening of the rete. In the acuminate variety the hair-follicles are first affected (Crocker).

Diagnosis.—When the papules are well marked (and in most cases a few are to be observed), they are distinctive of the disease. It is when the patches enlarge, and the disease becomes generalised, that it may be confounded with chronic eczema or universal psoriasis.

Prognosis.—This is only grave in generalised cases, in which the patient may drift into marasmus.

Treatment.—The general health must be dealt with, especially in cases of nervous exhaustion, by means of iron, quinine, or cod-liver oil. Itching must be combated by rest in bed, and the application of antipruritics. Arsenic should be tried and persevered with in all cases where it can be borne; the two conditions in which it is contra-indicated being dyspepsia with constipation, and acute disease, in which it often makes the skin worse. External treatment is of great assistance. Soothing applications, if the eruption is acute, such as lead and calamine lotions; mild tar lotions if they can be tolerated—Liquoris carbonis detergentis ʒii. to ℥vi. of water; oleum cadinum; or even inunctions with soft soap and pix liquida, if the patches are very chronic, and do not resent such treatment after trial.

9. **Lichen Scrofulosorum.** — Lichen scrofulosorum is another affection first described by Hebra. It is extremely rare in this country, although it undoubtedly exists, especially amongst the poorer classes. It is characterised by pale papules, approaching the colour of the skin; these tend to range themselves in circular patches, not circles, generally on the trunk rather than the extremities. The papules are scaly, and after a time disappear, leaving small yellowish pigmented spots. Here and there a papule inflames, and becomes acne-like. There is little itching. The disease occurs in scrofulous subjects. When occurring in adults it might be mistaken for the small papular syphilide. Cod-liver oil is the remedy internally, and also externally by inunction.

Alfred Sangster.

LIEBENSTEIN, in Saxe Meiningen.—Chalybeate waters. *See* Mineral Waters.

LIENTERIC (λεῖος, smooth; and ἔντερον, the intestine).—A form of diarrhœa in which the stools contain much undigested food, in consequence of its having passed rapidly along the alimentary canal. *See* Diarrhœa; and Stools.

LIFE ASSURANCE.—The great extension of life assurance of late years has placed the solution of important questions involving large financial operations within the range of the daily work of the medical practitioner. It is important, therefore, that his duties and the nature of the knowledge required of him should be defined. We shall dwell briefly on the nature of life assurance, and point out the rules which should guide the medical adviser of a life office in forming an opinion. We shall then consider the principal agents which modify the duration of human life, and their bearing on the questions submitted to us. Life assurance is a contract of indemnity. The amount of the indemnity to be paid on death is fixed by each individual according to his means or wishes, and the company engages to pay the sum when life fails or under other conditions, in consideration of an annual or other payment or premium so long as the contract lasts.

Irrespective altogether of health, the risk undertaken by the company is greater or less according to the variation in two factors: (1) the age of the life to be assured; (2) the duration of the term of assurance. The premium required for an assurance on a life aged forty, is greater than that for a life aged twenty; and again the premium for an assurance over the years of life from forty to sixty is greater than that for an assurance from forty to fifty only. As the premium is calculated on the assumption that the proposer has a chance of surviving to the extreme limit of life, it is obvious that the company ought to insure at the ordinary rate of premium such lives only as have the best chance of attaining to old age, or, as they are called, *first-class lives.* Hence lives coming under any of the following classes must be discarded from the first-class standard:—

(1) Lives not possessed of sufficient vital power to afford them the possibility of attaining old age. This will include lives which have shown a tendency to certain diseases which will develop later on in life, as gout, rheumatism, &c.

(2) Lives whose family history discloses a tendency to a breaking down short of longevity.

(3) Lives whose place of residence or occupation has a more than usual effect on life, or involves peculiar hazards.

Generally, lives which fall short of the highest standard in respect of one out of these three conditions may often be accepted, but if they fail of the highest level in more than one condition they must be excluded. The ideal, therefore, which the medical examiner should set before himself as constituting a first-class life, is the exclusion of these three conditions.

The tables of *expectation of life* put before medical examiners, which are deduced from the Institute of Actuaries' H^M tables, and are based on the mortality of healthy males whose lives had been assured with twenty British life offices, are often misunderstood. Expectation of life indicates the average number of years which is lived by all persons of a common age, from that age up to the extremity of life. The total number of years that will in the aggregate be lived by a group of persons of the same age, divided by the number in the group, gives the 'expectation.'

The medical examiner is for the time being the retained adviser of the office which employs him. Any medical man may decline to act for a company, but, if he has accepted a fee, he is bound to consider their interests as of primary importance, and his relations with his patient as secondary. He should not, therefore, allow himself to be swayed by motives of personal friendship, or because he is or has been the ordinary attendant of the proposer. Generally speaking, it is not judicious to employ the ordinary medical attendant of a proposer to report for an office, but it is often necessary to obtain his evidence confidentially, and, unless he decline to act, he is bound not to withhold any information he may have regarding the health, habits, or family history of the life. Every examiner should be aware that his report and opinion are necessarily submitted to the physician of the company, and thus a greater accuracy in the use of medical terms will often be observed.

The examiner will have an interview, always private, with the proposer, who should not be accompanied by anyone. The wife may ask that her husband or friend shall be present, but this is not advisable. Persons of either sex are always more frank when alone with their doctor. There may indeed be ailments kept secret even from a wife or husband, or former events in life bearing on health, which would not be revealed in the presence of a third party. It is scarcely necessary to advise that the utmost courtesy and quietness of manner should be observed, and the proposer placed at his ease as much as possible. A deterrent inquisitive manner is apt to give rise to prevarications or concealment in the replies given.

An inquiry into the functions of the body is often resented when put abruptly, but the writer has never failed to obtain all necessary information by a quiet questioning. He is in favour, however, of direct questions, plainly spoken out, especially with women; but *many* questions of the kind are to be avoided.

Regarding temperance, it is generally useless to put the question directly to a proposer. His estimate of what constitutes excess may not be yours. His opinion of his own habits may be comparative as regards his neighbour, and he may be a dram-drinker (the worst form of excess) but never 'get drunk'! It is well to approach the subject with inquiry as to his hours, habits, neighbourhood, and society, and thus elicit both his favourite drink, and how often it is taken.

The proposer being placed in a good light, the examiner will notice his general build, corpulence or otherwise. The face and hands will especially occupy him. The face may indicate intemperance, sensual habits, or nervous excitability. It should be neither pale nor flushed, free from blotches, and the nose not unduly red. The drunkard's nose, protuberant, granulated and rosy at the end, is often associated with a blear-eyed state of the eyelids. There are some forms of skin-affection which simulate it, but the practised eye will discriminate the chronic effects of alcohol which, by impairing the elasticity of the capillaries, has given rise to the nose here indicated. A flushed state of the malæ may lead us to suspect phthisis; while redness of the cheeks composed of permanently dilated blood-vessels, together with a velvety integument exuding sebaceous matters, always caused Brinton to suspect kidney-disease.

The hand affords evidence of various kinds, and its form, colour, and nails should always be regarded. We may thus detect gouty thickening; or, from the clubbed state of the fingers and incurvated nails, be enabled to detect chronic phthisis, or old pleuritic or pericardial disease. The tongue should be examined, not only as regards its being furred, fissured, moist or dry, but also for ulcers or growths, which, if present, should always be examined by pressure of the fingers. The throat may also give evidence of present or old syphilitic ulceration. The gums may present the blue line of lead-poisoning, or the dark-red line of phthisis. The gait, nervousness of manner, twitching of muscles, inability to walk straight, peculiarities of the eyeballs and facial muscles, or other symptoms, will betray some deep-seated affection of the nerve-centres, and the patellar reflex should be examined if any suspicions arise. Tremblings or shakiness of handwriting may indicate alcoholism, or abuse of tea or of smoking.

The teeth may be deficient or carious, and their condition is often a good test of general health. The notched teeth of syphilis should always be looked for. Finally, the whole aspect of a man should be noted, as conveying that he is robust, hearty, and vigorous, or the reverse, well developed in muscle of chest and limbs, or puny and weak, with loose tissues and flabby muscles.

The chief duties of the medical examiner are to ascertain with precision:—

(1) The *family history* of proposer; (2) his *past history*; (3) his *present state* of health; and (4) his *habits*.

1. The *family history* is to include not only his parents, brothers and sisters, and grandparents, but the health and ages at death both of them and their descendants collateral to proposer—that is, of uncles, aunts, and first-cousins. These facts need not all be recorded in the report paper supplied by the office, but their elucidation often enables the examiner to form an opinion as to the eligibility of a life where any taint, as consumption, gout, or cancer, exists in one generation.

2. The *past history* of a proposer will occupy us with much care. He is bound to tell us whether he has ever had any serious ailment; but, as memory is fallacious, the direct questions which are found in every form of medical report issued by the offices are to be put. It will be convenient then to ask in detail whether he has had symptoms of diseases affecting the chest, head, and abdomen, or any disorder of a general kind, as fevers; and young men should be plainly asked about syphilis.

Inquiry should be made as to former residence in an unhealthy climate; also whether proposer has had any medical attendant, and, if so, for what.

3. The *present state* of health is then to be ascertained, and a careful examination made of chest and abdomen. We cannot insist too strongly on the necessity for *uncovering the chest.* Without this, percussion

cannot be practised, the expansion, the movements, and alterations in the walls, caused by congenital malformation or by former disease, as pleurisy and phthisis, must escape notice. The heart-sounds cannot be estimated through the dress; and we have known many instances in which morbid conditions were overlooked because the proposer was so examined. There are heart-murmurs and lung-sounds which can be simulated or disguised by a well-starched shirt. For the examination of the *abdomen* the waistband should be unloosed, and palpation and percussion practised, by which the existence of enlargement of the liver or spleen, or of tumours, may be ascertained, and in doubtful cases the reclining posture should be adopted.

4. By the *habits* of the proposer we understand his general mode of living, and his opportunities for exercise, but above all his temperance or excess in the use of stimulants. The writer advises that the average quantity of stimulants taken daily should be written down from the reply of proposer on the document which he has to sign. The testimony of friends is always asked on this point, but the replies are generally fallacious, and often consist in a 'Yes' or 'No' to the queries sent to them. In proposals important as to amount, a written statement as to the friends' estimate of the habits of a proposer should be obtained in the form of a letter, and not on a printed form.

Certain other points may now be briefly discussed.

5. *Age.*—Before considering the diseases which shorten life, some general considerations about age are worthy of note. Different ages predispose to particular diseases. Respiratory diseases prevail most from puberty to twenty-five, and this is the age when phthisis is most fatal. It has been reckoned that at forty half the danger from this disease is over, and three-fourths at fifty years of age; and the rule seems a fair one. An heredity to the development of phthisis at a somewhat advanced age—say after forty—may, however, exist, and prove an actual danger to life. The liability to certain diseases, as gout, apoplexy, degeneration of organs and blood-vessels, and also urinary affections, increases after forty, and it is at and after middle life that the temptation to excess in diet and stimulants, with a diminished desire for exercise, leads the way to slow organic alterations. Persons who attain to great age are generally spare, and have in almost all instances been frugal in their habits, and active in mind and body. The decay of muscle and of organs is precipitated by want of use, and the due exercise of all faculties of mind or body is conducive to longevity. It is good to compare the apparent with the actual age of a proposer. As a general rule, when he is really older than he looks, his expectation of life surpasses the average, and when he has aged beyond his years the risk is thereby so far impaired.

6. *Occupations.*—The life which is protected from the vicissitudes of fortune by a fair provision for daily wants, which has occupation for both mind and body, without undue strain or the necessity for hurry, and which has daily exercise in open air, combined with a moderate amount of sedentary work—is undoubtedly the best risk. The clergy are perhaps the best lives of all callings, and the statistics of the clerical offices bear out this statement. Teachers, heads of schools, lawyers, and physicians probably come next. The 'business' class, which includes merchants, stockbrokers, bankers, manufacturers, directors of companies, &c., is fairly healthy, and stands among the first on the list, but the examiner will do well to remember the anxieties incident to all these callings.

There are certain classes exposed to manifest dangers, for which special rates are demanded by all offices. Thus the publican is charged 1*l.* per cent. extra for occupation, a sum which appears to be scarcely sufficient.

7. *Heredity.*—Heredity plays an important part in the life-history of every individual, as there can be no doubt that physical, mental, and moral characteristics are often transmitted from ancestors. The whole constitution may not be so communicated; and parents may be mere transmitters along a chain, their offspring representing an earlier ancestor. The examiner will therefore inquire both about parents and grandparents. In tracing the effects of transmitted disease we should find how far others of the same generation, as brothers, sisters, and cousins, may have been affected by it. We have thus a gauge of the intensity of the transmission. Longevity, which implies the perfection of the whole animal system, is no doubt hereditary in some families. If both parents have been the subject of the same disease, the heredity is intensified in the offspring. A disposition for zymotic diseases is marked in certain families. The heredity to insanity is intensified by successive inheritance; to syphilis is lost in the repetition of inheritance. Phthisis and cancer become intensified by inheritance, and appear earlier in each generation. Double inheritance (both parents) induces earlier and a more rapid form of disease. Heredity appears to influence the sexes equally. *Forms* of disease run in families: in some the consumptive taint is shown in acute tuberculosis, in others the most chronic form of fibroid phthisis prevails. The *mother's* transmitting influence seems greater than the *father's*, and it is common to all hereditary diseases for the mother to transmit to sons and the father to daughters. *Family phthisis* appears at an earlier age as we descend the genealogical tree; thus,

the grandfather may have it at sixty, his sons at forty, and his grandsons in early life.

Cancer is hereditary in one-third to one-seventh of the cases. It is most prevalent between forty and sixty. The encephaloid form is met with earlier; schirrus from forty to fifty; epithelial cancer later. The risks of hereditary cancer therefore increase with age after a certain point, while those from phthisis diminish. The rule must be to reject the issue of two cancerous parents. The heredity of *rheumatism* and *gout* is incontestable. Hereditary gout appears early, often at eighteen to twenty; acquired gout appears about forty. If both parents, or even one, have had several acute attacks of rheumatism, there is great likelihood of transmission to the child. *Diabetes* is allied to gout and rheumatism, and comes after the latter in frequency of heredity. *Heart-disease* claims the same heredity as gout and rheumatism; and while the acute form in the parent is apt to be represented in the child, it is not to be forgotten also that such parents commonly transmit a tendency to slow thickenings of the valves to their children, who may never suffer from the acute form. The many instances of valvular lesions met with in practice where the individual has had no acute attacks, may often be thus accounted for. If one parent have had gout or rheumatism severely, the proposer being in perfect health, the heredity may be overlooked; but if both parents have had these affections the life should be declined, or a large addition made to the premium.

It has been found that *asthma* was hereditary in fourteen cases of thirty-five, and in seven it was paternal and direct. The most frequent period of development was in youth, and next in old age. If both parents were asthmatic, an addition should be made to the premium. *Albuminuria* may be regarded as only transmissible when the result of gout or alcoholism in the parent.

Intemperance must be considered as hereditary in a high degree. It runs in families, who not only inherit the nervous constitution which drunken parents transmit, but that peculiar temperament which flies to stimulants as a resource on any emergency of life. The *craving* for drink, a want which alcohol can alone supply, as it stops for a time the waste of nerve-power, is often derived from the excesses of drunken parents.

Still further, the children of drunkards inherit various neuroses, such as hysteria, epilepsy, mania, ataxy, and different forms of paralysis; and a child begotten during drunkenness early falls a victim to either phthisis, or some deep-seated disease of the nervous system. Intemperance is perhaps the most formidable enemy to the safe assurance of life, and even ranks before phthisis in its deadly effects on the system. Organic ailments are by it originated, and organic weakness crystallised into disease. The degenerations of age are anticipated and precipitated by alcohol, and the dram-drinker is sure to have a shortened life. The man who carries his drink well and is 'never drunk' is in the greatest danger. Small doses of stimulants throughout the day, ended by a somewhat larger one at night, leave the system always charged with alcohol, and the excretory organs are continuously under its influence. The most searching inquiry should therefore be made as to the quantity taken each day, and the frequency of the dose. The medical examiner must be thrown on his own tact to discover from certain well-known indications whether the proposer is a drinker. Among these are the flushed face and nose, the tremulous tongue or hand, the relaxed skin, the eye, and the manner over-rapid and nervous, or subdued and sullen. Of all classes of the intemperate the habitual dram-drinker is the worst. The occasional drunkard is not in so great a danger, and no doubt is often reclaimed; but the writer cannot recommend the acceptance of any of those for life assurance, as no addition to the premium would compensate the certain loss to the company.

Diseases of the nervous system are eminently heritable, as epilepsy, general paralysis, and mania. Of 321 epileptics, one-third had epileptic parents. The children of such become diseased early, but it may be considered that after forty the liability is exhausted.

Insanity is commonly hereditary: about one in three or four have had a parent insane. The issue of one insane parent might be accepted if the age be 35 or 40, and the proposer free from any nervous affection.

PERSONAL EXAMINATION.—The medical examiner should ascertain the condition of the chief organs of the body, especially the heart and great vessels, the lungs, and the kidneys.

Heart.—The size of the heart and the strength or weakness of its impulse should be ascertained.

Intermission of heart-beat and pulse, if unaccompanied by other irregularities of rhythm, may not be of grave importance. If it be only a loss of beat once in twenty or thirty it may be regarded as harmless, or referable only to an alteration in the innervation of the heart. It may not be always present, may be indeed absent for days or weeks, or be suspended during a feverish attack, or present only during some trivial alteration of digestion.

Irregularity of heart-action is of different import. The heart will repeat a number of rapid beats, then pause, and lose one or several successively. The sounds are confused in character and run into one another, the impulse is diminished, and the interval lost or irregular. Feebleness is the predominant character. In this condition, degeneration of heart-muscle has already commenced.

A *tumbling* but forcible and struggling heart-beat is not to be confounded with the above. It is a common result of pericardial adhesions and hypertrophy. The danger to life would probably arise from the consecutive events of hypertrophy, dilatation of the heart's chambers, and valvular incompetence.

Murmurs may be audible over any of the valvular regions of the heart, and accompany either the first or second sound or both.

The *characters* of a murmur—its softness, flowing, harsh or rasping sound—are *per se* no indications of its value or pathological import: a harsh or a loud murmur is often of a less serious nature than one more distant and less pronounced, as the power of the ventricle behind the obstruction is generally the cause of its loudness, and a moderate degree of hypertrophy is a compensating agent. If there be obstruction at an orifice, all symptoms of heart-disorder may be held in abeyance for years if only there is power to drive the blood through the obstructed valve. It is only when the heart fails to do so that the serious symptoms of dilatation are initiated; or if the valve permit of regurgitation, and the muscular walls of the cavity into which the blood is returned be efficient in contractile power, the dilatation is opposed and all its concomitant symptoms are absent or delayed. *Ephemeral* murmurs often give rise to doubts as to the safety of assurance—such as occur in the left subclavian region, when firmly pressed by the stethoscope, or in certain positions of the person examined, or in that portion of heart which is covered by the lung. They may be heard on deep inspiration only, and are temporary in character. They are not to be regarded as prejudicial to life. The *anæmic* murmur, soft, systolic, and blowing, is heard over the first part of the aorta or pulmonary artery. It is occasionally heard over the mitral region. It is associated with a lowered condition of general health due to anxiety, over-work, or loss of sleep; and if these conditions are altered, the individual may recover from all his symptoms and lose the physical signs. But it is not to be forgotten that fatty degeneration of the walls of the heart has been found in cases of prolonged anæmia. The insurance rule is to defer such cases for a month or two.

The lesions most important to consider are those of the aortic and mitral valves.

Aortic murmurs may be single or double. The single murmur is probably obstructive, the valve being thickened and warty, and the coats of the vessel diseased.

In *aortic regurgitation*, recognised by a diastolic murmur, the greatest degree of ventricular hypertrophy occurs, and the heart attains an enormous size in compensatory efforts to maintain the systemic circulation against gravity, the open valves permitting the return of a large portion of the blood into the ventricle. The carotids are seen throbbing, and the radials present the well-known character caused by sudden recession of the blood-current called the water-hammer pulse. This form of disease is among the most fatal of heart-affections, and is entirely uninsurable, the elements of durability being wanting.

Mitral murmurs are the most common effects of rheumatic endocarditis, which results in the thickening of the valve, and stenosis, or permanent imperfection, permitting regurgitation into the ventricle. The recognition of these cases is easy, but their value for the purposes of life assurance depends not on the character or situation of the murmur, but on the actual conditions, which we shall now consider.

It is now a well-ascertained fact that persons in great number having a marked mitral murmur may live to advanced age without presenting any symptoms, and therefore without the effects of heart-disease recognised as injurious to life; and of this the best medical authorities have recorded numerous instances. The first downward step in the fatal event of mitral disease is when the cavities of the heart begin to yield to the pressure of the regurgitated blood, and dilatation follows. With dilatation a thinning of the muscular walls begins, and degeneration of fibre follows as a necessary sequence. With lessened power of the ventricle, engorgement of the right side of the heart occurs, the return current is blocked in the auricle, which in its turn dilates, the lungs become congested, the return of systemic venous blood is retarded, and the phenomena of congested lung, shown by œdema and hæmorrhage, and of congested venous and capillary systems, evidenced by dropsy and effusions, are certain to follow. The series of events is mechanical; and it may be stated that, so long as the muscular integrity of the heart's walls is maintained, the subject of the affection may enjoy fair health with ordinary precautions. The dangers to such a life would probably arise after middle life, at the period when degenerations of structure commonly commence. The rule of assurance companies has till lately been to reject all such lives as present any form of mitral disease; but if a case present with murmur only, without great enlargement of the heart, if the ventricular contraction be strong and the murmur well pronounced, and if, in addition, it can be shown that such condition must have prevailed for a long time—say, from the date of one attack of rheumatic fever years previously, if the proposer has his other organs healthy and does not exceed thirty-five years of age, then it is safe to accept such a life with a considerable addition to the premium, or by securing that all the premiums should be paid up in a short term of years—say, eight or ten.

It remains to say of heart cases that the most dangerous are those indicating failure of muscular power, and that the aortic cases are more perilous than the mitral. The presence of albumen in the urine should always be looked for in connexion with disease of the heart.

Pulse.—The frequency of the healthy pulse varies with the constitution of the nervous system, and the posture, sitting or standing, of the individual. Its healthy beat might average 60 to 70; but a large range should be allowed for temperament and emotional causes, the very fact of its being examined giving rise to acceleration. The physician will therefore give time for its subsidence, or make a fresh examination on another day. A sustained frequent pulse may indicate fever, phthisis, or exophthalmic goître. The fulness or incompressibility of a pulse, and a character of wiriness under the fingers, should be noticed. The latter may indicate sclerotic changes in the vessels, when the condition of the temporals and other arteries should also be examined.

Chest.—A careful examination of the lungs should be made by palpation, percussion, and auscultation, the dress being removed, and measurements taken by a tape at the level of the sixth rib. These vary in different individuals, and from 33 to 38 inches have been given by different observers as the average in adult males. The difference between extreme inspiration and expiration should not be less than two inches at the level of the nipple. It may be taken that the *mobility* of the chest is of more importance than its size. Attention should be paid to any undue flattening of the chest-walls, such as may have been caused by phthisis or old effusions. Should a spirometer be available, it will be found that a healthy man of average build can expel from 200 to 250 cubic inches of air, which represent his *vital capacity*, leaving still behind a certain amount of residual air which cannot be removed by any expiratory effort; and every inch in stature above five feet should add eight cubic inches to the vital capacity.

Phthisis.—The great prevalence of this disease renders its study from an insurance point of view of the highest value. According to the Registrar-General, one death in every eight is due to this cause. We need not dwell here on the methods of recognising existing phthisis by its physical signs; but if these latter are undeniably present the life cannot be considered insurable, unless for very short periods, and even then on terms which would be rarely accepted by a proposer. However, as every condition of health has its insurance price if we could appreciate its possible future with anything like accuracy, it is well to remember that certain forms of phthisis are necessarily very chronic. Of these, fibroid phthisis and a well-defined single cavity in one lung are illustrations; but, if it were possible to accept them for insurance purposes, their chronicity should have been already shown by a long previous history, and the actual state of proposer be without either fever or much wasting.

Hæmoptysis.—There is no question more frequently before the medical examiner than the influence of blood-spitting on the value of life. We have met with the following varieties:—

(*a*) After a run or strain in athletics, as rowing or lifting weights, a mouthful of fluid blood has been brought up, a few clots some hours, or next day, after; and then a total cessation of the symptom occurs, without any subsequent disorder of health.

(*b*) The patient having had cold or cough for a week or two, a 'few streaks' of blood mixed with phlegm have been brought up, or a spoonful of red blood in the morning on waking, and the symptom has recurred after an interval of days or weeks.

(*c*) Without acknowledged disorder of health, or cough, a robust or, it may be, a spare person may bring up a mouthful of fluid blood, dark, or it may be in clots, for a day or two, when it ceases, without any symptom of illness, but may return, and probably will return, some time after, as weeks or months.

(*d*) A copious blood-spitting, a cupful or pint, fluid at first, then clotted, possibly repeated in a day or two, with or without any manifest disorder of health.

Such are the most common descriptions of blood-spitting which are given us orally, or reach us as medical reports from examiners. As we are dealing with reports only, we do not mention the symptoms, such as bodily temperature, which should guide us if we had the opportunity of seeing the patient at the time.

(*a*) is the usual story of hæmoptysis from strain or injury, and may occur without any subsequent ill-health. It is common among the young and robust, and is a simple overflow resulting from high pressure. Should an interval of months have elapsed since the occurrence, and the health remain good, and the absence of any physical signs of lung or heart-disease be verified by examination, such lives may be accepted, with a small addition to the premium, especially if the applicant have passed thirty years of age. Of course an abstinence from over-exertion of any kind should be insisted on.

(*b*) is the characteristic of commencing phthisis, and, as grave disorders of general health, as well as physical signs of lung-disease, will be manifest, the life is plainly not insurable.

(*c*) is probably of cardiac origin, or due to hæmophilia. That from heart-lesion is met with in two very distinct forms. The more severe is commonly due to mitral disease, and occurs late in the history of disorders dependent on that cause; and venous congestions, with evidence of dilated heart-chambers, will have generally been in existence long before a hæmorrhage into the lung takes place. As this case does not often present for life assurance we need not further consider it.

The milder form is of not infrequent occurrence. A person commonly under thirty-five will have brought up blood from the mouth on various occasions, fluid, but more commonly dark or clotted, and have but little disturbance of health. There is commonly no cough, nor any expectoration, and only slight dyspnœa may be complained of. The most careful examination will detect nothing wrong in the lungs, and the subjects have commonly large and well-made chests. There is no rise of temperature at or after the attack, and the nutrition of the body is perfect. The writer has examined very many such cases, and in all the only physical sign was a slight click with the systole at the apex or lower end of the sternum. He has watched many of them over a series of years, and found no more serious symptom than here stated. There is little doubt that they are chiefly mitral imperfection, and, as they may eventuate in serious disease, are not eligible for ordinary life assurance. It might, however, be possible to accept some of them for very short periods at an advanced premium. *See* HÆMOPTYSIS.

Emphysema.—Proposers often present the physical signs of emphysema, especially at the bases of the lungs. The proposer may or may not be the subject of fits of asthma, but the breath is always short on exertion. The co-existence of bronchitis shown by *râles* of the dry, sonorous, or mucous character, most marked with expiration, is often found, and eventually few advanced cases remain unassociated with heart-failure. Cases of this kind, excepting those which present heart-symptoms, may be accepted with an addition to the premium, the amount of which will vary with the mildness or severity and the rarity or frequency of the attacks, and the degree of loss of elasticity in the lungs. The liabilities increase with age, and the premiums should be paid up before the proposer is much beyond middle life. A short occasional attack of asthma, without the characteristic physical signs, may not materially vitiate a life.

A liability to *bronchial attacks* manifests a delicacy of the air-passages, and is often observed in persons of a phthisical, gouty, or syphilitic family. Chronic bronchitis in the elderly is commonly found in emphysematous cases, and the gradual supervention of changes in the air-vesicles and chambers of the heart renders such lives precarious. They are, however, occasionally accepted for a short term, and with a considerable addition to the premium.

Pleural effusions, if existing, would prevent the acceptance of a life, but neither a contracted side from absorption of a former effusion, nor the marks of paracentesis for the evacuation of the fluid, if the recovery has been complete, and the lung has descended to nearly its former level, should forbid acceptance if the general health be good.

Digestive tract.—The tongue and fauces should in all cases be inspected. The salivary glands should be free from hardness or enlargements. The fauces should be examined for marks of former ulcerations. The nostrils should be free from obstruction, and the voice not nasal. The stomach should be examined by palpation and percussion, as stricture of the pylorus, or dilatation, may be present, and if found would justify rejection of the life. The *liver* should not come below the ribs, and a breadth of about two fingers should represent the normal dulness from the lower ribs upwards. Inequalities on the surface of the liver may mean cancer or cirrhosis or hydatids, and their presence would justify exclusion. Mesenteric tumours, fibroid, scrofulous, or malignant, are not admissible. Hardness in the right iliac fossa, especially with a history of former typhlitis, is also inadmissible. Any of the following affections, if known to have existed, should be regarded with suspicion: Hæmatemesis, gastralgia with vomiting, hepatic colic, hydatid cysts, obstruction of the bowels, typhlitis or perityphlitis, and ascites. There are cases of *hæmatemesis*, generally in the female, or the result of strain or direct injury, which might be accepted, but only after years of perfect health have elapsed. *Jaundice* of former occurrence, if the attacks have been slight and not traceable to liver-disease, would not forbid acceptance. *Biliary colic*, if the attacks have been severe or recent, would prohibit acceptance; but a former attack, with subsequent years of good health, need not imply rejection.

Dysentery which may have occurred in a hot climate, from which the proposer has been absent for some years, with good present health, need not disqualify, but a considerable extra premium will be required if the proposer returns to a hot climate.

All disorders of the *rectum*, except hæmorrhoids of a simple kind, are serious. Cancer, abscess, or the syphilomata, may be suspected if symptoms of pain or obstruction can be elicited. *Hæmorrhoids* need not disqualify unless they be of a severe form, or have recurred after operation, or presently call for surgical interference.

Genito-urinary organs.—Disorders of these organs are among the most important which affect the value of lives. They are often very insidious, as persons in a state of disease may present the appearance of perfect health. It is notorious that a man may have glycosuria or albuminuria, and neither know it himself nor exhibit in his appearance any evidence of the disorder. It is therefore imperatively necessary that the urine should be tested chemically in every case. This rule was formerly not adhered to, and many offices suffered in consequence; but it has now become a general practice, which has in some instances to be supplemented by a microscopical examination.

Hæmaturia of recent occurrence, and *stone in the bladder* would forbid acceptance. *Dysuria* from stricture or enlarged prostate are unfavourable conditions, but there are mild cases of stricture which may be accepted with an addition.

Syphilis.—Syphilis affects the duration of life considerably, and is to be regarded not only from the length of time which has elapsed since the last attack and its cure, but from the nature and degree of the symptoms. The late Berkeley Hill believed that the curable cases get well in two years; the incurable may last for an indefinite time. For two years a person may expect a return of the eruption. Tertiary affections generally appear about five years after the primary affection. Mr. Arthur Cooper endorses this view. The assurance rules may be thus stated: During the actual existence of any syphilitic disorder the proposal should be postponed. A man who has had syphilis in only the ordinary cutaneous and superficial form, and has been properly treated for it, may be accepted after a year has elapsed without symptoms. If he have had syphilis in the secondary forms, he should only be accepted if two years have elapsed since the latest symptom, and then with a small addition to the premium. Those who have had visceral syphilis affecting the brain, cord, liver, lungs, kidneys, &c., should be rejected.

Albuminuria is found in several chronic affections of the kidney, and in acute nephritis. It is also present in several acute inflammatory affections, with which we are not now concerned. Its presence should always be looked for in the urine. It is usually more copious after food and exercise, and its appearance in the urine is often intermittent, being absent at times for hours or even days. Acute albuminuria from exposure to cold and wet, and that which follows scarlatina, may disappear without leaving any organic change in the kidney, but in certain cases it recurs. If, however, some years have elapsed since its occurrence, and the proposer have enjoyed perfect health, the case may be accepted. In chronic cases, it is most commonly the result of some form of Bright's disease. There is, however, no doubt that albuminuria occurs in many persons without any other symptoms of disordered health, and may so continue for years. According to Professor Grainger Stewart, the proportion of cases of albuminous urine found in presumably healthy persons is 30 per cent. He examined 407 cases. In all, the maximum quantity was found after breakfast. Dr. Saundby and other observers have reported cases of albuminuria which had lasted twenty years without disorder of health. Sir George Johnson considers, however, that its presence in the urine is always pathological; that nearly all cases pass through the stage of intermission, which may last for long periods; and advises that no one with a trace of albumen in his urine should be accepted at the ordinary rate. We should advise the following rules for practice:—

Albuminuria, formerly existing as a result of acute nephritis or scarlatina, with an interval of perfect health for years, need not disqualify a proposer. Cases of albuminuria presently existing, and known to have existed for years, in persons of otherwise perfect health and good family history, may be assured for a short period—say of five years—with an addition to the premium, and may come up for examination again at the end of that period. Cases of albuminuria with any of the symptoms of *chronic Bright's disease*, with any cardiac, gouty, or rheumatic complication, or any suspicion of intemperate habits, should be declined. For the tests for albumen, *see* ALBUMINURIA.

Casts in the urine, whether epithelial, hyaline, waxy, colloid, or amyloid, if present, would tend to confirm the diagnosis of organic disease of the kidneys.

Glycosuria.—Sugar may be present in the urine without diabetes, of which all the symptoms may be wanting. Glycosuria is often a temporary condition, and may disappear leaving no ill effects; but it is always to be regarded with suspicion, and its presence alone should forbid the acceptance of a life. It is common in obese persons, gross feeders, and in the gouty habit; and its subjects may have no suspicion of its existence, and feel in perfect health. The urine should therefore be always examined for sugar. Diabetes is a permanent, but glycosuria may be a temporary condition, and the mortality from it increases with age up to sixty or seventy years. Males are twice as liable as females. It is difficult to measure its duration, as dietetic measures can much retard its progress; but the prognosis, on the whole, is bad, as the liability to cerebral affections, to phthisis, carbuncle, and other fatal complications is very great. Its subjects, therefore, must be excluded from life assurance. Glycosuria will forbid the acceptance of a proposer while it exists; but if there be no gout, and if all traces of sugar have disappeared for years, a calculated addition might be made to the premium. In glycosuria the quantity of urea is generally increased. A high specific gravity, even above 1030, is no evidence of sugar in the urine, unless a chemical examination have proved its existence. For the tests for dextrose, or grape sugar, *see* Diabetes Mellitus.

The excess of *phosphates* in the urine is generally temporary, and often due to anxiety and waste of nerve-power. It is recognised by a cloudiness on boiling, which is entirely cleared by the addition of a drop or two of nitric or acetic acid. It forms no obstacle to the acceptance of a life.

Disease of the *testicle*, tubercular, strumous, or malignant, disqualifies for assurance. *Hydrocele* and *varicocele* may *per se* be regarded as harmless.

Female organs.—Metritis, *pelvic* inflammation, or ovarian disease, are doubtful cases for acceptance. Women who have had repeated abortions, puerperal hæmorrhages, eclampsia, or a necessity for obstetrical operations, are not eligible unless the menopause has been favourably passed. During a *first pregnancy*, it is well to defer assurance till after a safe confinement. In 3,722 *primiparæ* Mathews Duncan found one death in every 74; and in 12,671 *multiparæ* there was one death in every 123. Lactation is no bar to acceptance. The average duration of life in women is longer than in men, and by latest returns is shown to be increasingly so.

Nervous system.—Diseases of this system, as cerebral softening, locomotor ataxy, hemiplegia, paraplegia, aphasia, disqualify a proposer. Local paralysis of the motor muscles of the eyeball, and ptosis, unless congenital, would lead to suspicion of brain-disease, and would not be acceptable. *Paralysis of the facial nerve* (Bell's), when purely local, and free from complications with disease of the ear and disorder of the fifth or other nerve, need not disqualify. *Paralysis* from lead-poisoning is always serious, and the liability to diabetes and deep disorders of the nervous system should not be forgotten. A recognition of the blue line on the gums would lead us to decline the life. *Neuralgias* of branches of the fifth nerve may not disqualify unless they be associated with cerebral symptoms, or be the result of syphilis or exostosis. *Vertigo* of a severe kind, associated with symptoms of *Menière's* disease, would disqualify; and even its more transient forms, if often repeated or associated with gout, may be a bar to acceptance. *Trembling of the hands* may arise from the abuse of tea, tobacco, or alcohol. If from the latter cause, we may expect the tongue to be also tremulous. Although it may be temporary, its presence should cause grave suspicion as to habits.

The more severe forms of *epilepsy* must forbid acceptance, unless ten or fifteen years have elapsed since the last attack, with an interval of perfect health, and even then an addition should be made to the premium. There is a mild form appearing in early life, which can generally be traced to such causes as overwork or too close application to study, and where the heredity is absent; if years have elapsed without its recurrence, and the proposer has passed thirty and has engaged in the active work of life without symptoms of nervous disorder, and is strictly temperate, the life may be accepted with an addition of five to seven years.

Height and weight.—The relative proportion of height and weight is important in estimating the probabilities of future disease in a proposer. In estimating over-fatness, it the chest and shoulders be large and the abdomen moderate in size, the condition is less important than if the abdomen were large and pendulous. In stout persons, therefore, the circumference of chest, abdomen, and limbs should be given, and flabbiness or firmness of tissue is to be considered, while habits as regards exercise, food, and stimulants should be carefully inquired after. The *dangers* of obesity are weakness of heart or ultimate fatty degeneration of that organ. In a large proportion of these cases, fatty degeneration has affected the liver, and atheromatous alterations take place in the coats of the arteries, which lead to their ultimate rupture and consequent hæmorrhages. Obese persons are also worse subjects for fevers and accidents than are the spare and muscular, their power of recovery being lowered from feebleness of circulation. For these reasons the very obese are scarcely subjects for life assurance, although occasionally, if their habits be moderate, they may be accepted with an addition. On the other hand, the existence of excessive *leanness*, which may be the result of phthisis, diabetes, or various other wasting disorders, demands a careful examination. Most companies have tables of relative heights and weights, but a wide margin must be left for individual variations. One is appended which the writer has found sufficiently accurate.

Height in inches	Weight		Height in inches	Weight	
	st.	lbs.		st.	lbs.
63·0	8	13	70·0	12	4
63·5	9	2	70·5	12	8
64·0	9	5	71·0	12	11
64·5	9	8	71·5	13	1
65·0	9	11	72·0	13	5
65·5	10	1	72·5	13	9
66·0	10	4	73·0	13	13
66·5	10	7	73·5	14	3
67·0	10	10	74·0	14	7
67·5	10	14	74·5	14	11
68·0	11	3	75·0	15	1
68·5	11	7	75·5	15	5
69·0	11	10	76·0	15	9
69·5	12	0			

Claims.—On the death of an assured life a claim is sent in to the office by the legal owners of the policy. This is accompanied by certificates from the medical attendant, and from the registrar of the district in which death occurred. The practitioner who has to certify the cause of death cannot be too distinct in his statement, and in avoiding the use of terms which express only the symptoms and not the disease which proved fatal. Thus *dropsy* is common to heart, liver, kidney, and other diseases, and should not be employed; and for the same reason *hæmorrhage* and *diarrhœa*, which are common to many affections, should not be used. *Gastritis*, when certified as a cause of death, should always excite suspicion. The writer has known it used to conceal irritant poisoning and intemperance. A sudden attack of persistent vomiting with diarrhœa, leading within a week or two to a fatal issue, should not be received without careful inquiries as to the assumed cause of death. *Syncope*, which may represent the final stage of many diseases, should not be used. *Childbirth* is often used to cover other affections, such as phthisis, and should be limited to incidents proving fatal at or soon after a confinement.

We have also occasionally to consider whether the death of a proposer has been due to diseases which must have existed at the time when the life was accepted, and therefore whether the statements made in the proposal as to the previous state of health and habits of a proposer were strictly true. If not true, the claim could not be maintained. There is here scope for all the acumen of the medical adviser of an office.

It is believed that the practising physician will find in this article sufficient data to guide him in the selection or rejection of most lives offered for assurance. It is not possible to lay down specific rules for the amount of additions to the premium which it will occasionally become the duty of the medical examiner to advise. He may either rate a life at so many years older, or adopt some of the other methods by which the company may be secured against loss—as paying up all premiums within a given number of years, or deducting a portion of the sum to be paid by the company if death occur within a certain time, or making the sum payable at a certain age (endowment). Although on all these questions of finance the medical adviser can only recommend, his opinion will be highly useful to the company, with whom the ultimate decision will rest.

James E. Pollock.

LIGHTNING, Effects of.—Synon.: Fr. *Les Effets de la Foudre*; Ger. *Blitzschlag*.

The effects produced by lightning differ only in degree from those produced by the discharge of static electricity, generated in the laboratory. With a Leyden jar of sufficient size a small animal may be killed, and in larger animals the effects of shock and local injury may be produced. By lightning a person may be killed outright, and a *post-mortem* examination may reveal no lesion whatever. The mode of death in these cases seems to be by the shock to the brain and nervous system generally. Effects not distinguishable from ordinary concussion of the brain may be observed, and the person struck may remain insensible, with slow respiration, scarcely perceptible pulse, and dilated pupils, for periods varying from a few minutes to more than an hour. This may be followed by complete recovery; or there may remain paralysis of the limbs, usually the lower, or occasionally derangements of the special senses—blindness, a metallic taste in the mouth, noises in the ears, and an odour in the nose. The brain may be more or less permanently affected, and we read of delirium, mania, and loss of memory as results of the lightning-stroke.

Various objective phenomena have also been observed. The electricity on its way through the body may produce a number of mechanical effects. Wounds like those produced by a blunt stabbing instrument may mark the points of entry and of exit; bones have even been broken, the membrana tympani has been ruptured, and internal viscera have suffered in a similar way. Patches of erythema, urticaria, superficial ecchymoses, and scorchings of the surface having a curious tree-like and branched arrangement, have all been described; and this last phenomenon has apparently given rise to the assertion that delineations of trees standing in the neighbourhood of the accident have been traced photographically on the body of the victim. Lightning is apt to be attracted by any metal worn about the body. Watch-chains are frequently broken and fused, and by the intense heating of these metallic conductors the clothing has been set on fire. Watches have been broken and partially fused, and have forcibly burst through the pockets in which they were contained. Steel articles, such as pocket-knives, have been rendered magnetic. The clothing is sometimes burnt and torn to a great extent, and strong boots have been found burst open, or thrown off the feet to a distance, or nails in the soles have been driven out of them.

The remote effects of lightning are due to the mechanical injuries produced by it. Permanent paralyses may result from injury to the nerves; and inflammatory action may be set up by the injury inflicted on internal or external parts. One case is recorded in which the whole of the hair on the head and body, as well as the nails of both hands, came off after a lightning-stroke. It has been asserted that *rigor mortis* does not occur in persons killed by lightning, and that the blood remains fluid for a very long time after death, but neither of these facts has been substantiated.

Treatment.—The treatment of those who have been struck by lightning consists in first rousing and keeping up the respiration and circulation. The cold douche is often of great value; and this, combined with friction of the limbs, warmth to the extremities, and the administration of stimulants, either by the mouth or in the form of enemata, would seem to be the measures best calculated to restore the suspended animation. Secondly, special injuries must be subsequently treated according to their nature.

G. V. Poore.

LINEÆ ATROPHICÆ (Lat. Atrophic lines).—A form of scleroderma. *See* Scleroderma.

LIPIK (LIPPIK), in Slavonia.—Thermal muriated saline waters, with iodine. *See* Mineral Waters.

LIPOMA (λίπος, fat).—A fatty tumour. *See* Tumours.

LIPPSPRINGE and INSELBAD, in Germany.—Earthy waters. *See* Mineral Waters.

LISBON, West Coast of Portugal.—Warm, moist climate, with very variable temperature. Mean temperature in winter, 54° F. Prevailing winds, N.E.–S.E. in spring; S.W. rainy. *See* Climate, Treatment of Disease by.

LISDOONVARNA, in Ireland.—Sulphur waters. *See* Mineral Waters.

LITHÆMIA (λίθος, a stone; and αἷμα, the blood).—A condition of the blood in which it contains excess of uric acid. *See* Gout.

LITHIASIS. LITHIC ACID DIATHESIS (λίθος, a stone).—*See* Gout; and Uric Acid Diathesis and Uric Acid Calculus.

LITHONTRIPTICS (λίθος, a stone; and τρίψις, friction).—Synon.: Fr. *Lithontriptiques*; Ger. *Steinauflösende Mittel.*

Definition.—Lithontriptics are therapeutical measures used for the purpose of dissolving calculi in the urinary tract.

Enumeration.—The chief lithontriptics are: Water, Potassium, Lithium, Borax, Phosphate of Sodium, Soap, Lime-water, Nitric Acid, Phosphoric Acid, Hydrochloric Acid, Sulphuric Acid, Piperazin, and Mineral Waters, such as those of Contrexéville and Wildungen.

Action.—Lithontriptics dissolve stones in various ways. Some of them possess a simple solvent action, as in the case of water. Others unite with the calculi so as to form a more soluble compound, as in the case of the union of potassium or lithium with the uric acid of a calculus, producing urate of potassium or lithium, which is more soluble than uric acid itself. In the case of phosphatic calculi, diluted nitric acid combines with the bases of which they are composed, to form a more soluble compound.

Uses.—Lithontriptics may be employed for the purpose of dissolving calculi either in the kidney or in the bladder. They may either be taken internally, so as to act upon the calculi through the medium of the urine; or be injected directly into the bladder. This latter treatment can only be adopted in the case of a vesical calculus, and is inapplicable in the case of a renal calculus. The most useful of all lithontriptics is water, and especially distilled water. When this is taken in large quantities, the urine becomes very dilute, and small calculi may be partially dissolved, so as to be reduced in size and ejected through the natural passages. If the calculus is composed of uric acid, potassium or lithium is the best remedy for internal administration, the urates of these bases being more soluble than the urate of sodium. Piperazin is a solvent of uric acid, twelve times as powerful as lithium carbonate. It has been used as a lithontriptic both internally and as a local injection into the bladder. In the case of phosphatic calculi, acid remedies are employed instead of alkaline; but it is exceedingly difficult to render the urine acid by means of acids given by the mouth, unless they are administered in quantities likely to derange the digestion. In place of mineral acids, benzoic acid and benzoate of ammonium have been employed, as benzoic acid passes out of the body in the form of hippuric acid, giving an acid reaction to the urine. On account of this difficulty, acids have been directly injected into the bladder, in order to act directly upon the stone; for which purpose nitric acid, largely diluted, is the one which has been most generally employed. This procedure, however, is now rarely had recourse to, as it is much easier to crush the stone by mechanical means. The two most important springs for the treatment of renal or vesical calculi are Contrexéville and Wildungen. The waters of both of these places contain carbonate of iron, which appears to aid their action.

T. Lauder Brunton.

LITHURIA (λίθος, a stone; and οὖρον, the urine).—A condition in which a deposit of uric acid or urates takes place in the urine. *See* Liver, Functional Diseases of; Uric Acid Diathesis and Uric Acid Calculus; and Urine, Morbid Conditions of.

LIVER, Diseases of. — Synon.: Fr. *Maladies du Foie*; Ger. *Krankheiten der Leber.*

The liver is an organ which has always occupied a prominent place, both with the profession and the public, as being the seat of important diseases, as well as the origin and source of numerous symptoms and ailments. Not only is it concerned in the formation of the bile; but it has also a peculiar glycogenic function; and is now generally believed to take an important part in metabolic changes, with the production of urea or uric acid, as well as in the destruction of red blood-corpuscles, peptones, and ptomaïnes. Moreover, the organ has a special portal circulation, by means of which the blood returning from the stomach, intestines, pancreas, and spleen is distributed throughout its substance, and thence conveyed to the inferior vena cava. Hence, hepatic affections, by interfering more or less with the physiological functions or anatomical arrangements of the organ, may give rise to diverse phenomena, not only of a local character, but also associated with the general system, or affecting some remote part.

Summary of Diseases.—The individual affections of the liver are treated of separately, in alphabetical order, but it may be well to indicate beforehand their general nature. The first great division is that into *functional* and *organic*. *Functional* hepatic disorders are commonly regarded as of peculiar significance, and of great importance. The main *organic* diseases of the liver, in which there is some more or less obvious anatomical change, may be summarised thus: 1. *Hyperæmia* or *congestion*, either active or mechanical. 2. *Hæmorrhage* into the organ, or so-called *apoplexy*. 3. *Acute inflammation*, usually terminating in *abscess*, rarely in actual *gangrene*. 4. *Chronic inflammation*, ending in the condition termed *cirrhosis*. 5. *Hypertrophy*. 6. *Atrophy*, either *acute yellow*—which is a very fatal disease; or *chronic*, the latter being of different kinds. 7. *Biliary accumulation* and *pigmentation*. 8. *Malpositions* and *malformations*. 9. *Infiltrations*, including *fatty* and *albuminoid* disease. 10. *New-growths*, especially hydatids, syphilitic formations, carcinoma, and sarcoma. Tubercle is occasionally found in the liver; and rarely lymphatic formations, simple cysts, erectile tumours, or other new-growths.

Ætiology and Pathology. — Taking a general survey of the causes which originate hepatic diseases, and of the circumstances under which they arise, the most important may be indicated as follows: 1. An affection of the liver may be merely a local manifestation of some constitutional or general malady, as in the case of cancer, tubercle, syphilis, or albuminoid disease. The liver is an organ very liable to suffer from albuminoid change. 2. Some local injury or irritation may originate hepatic disease, either from without, as a blow or stab; or from within, as sometimes happens in the case of biliary calculi. 3. Certain animal parasites entering the body are prone to lodge in the liver. This applies especially to hydatids, originating from the *Tænia echinococcus*. 4. From the intimate connexion of the liver with the alimentary canal, especially through the portal circulation, hepatic disorders are very liable to arise from improper diet, as well as from digestive derangements affecting the stomach and bowels, and as a consequence of constipation. 5. Abuse of alcohol, and especially indulgence in ardent spirits, occupies an important position in the ætiology of disorders and certain diseases of the liver. Undue use of hot condiments is also regarded as a factor of some consequence. 6. Long-continued exposure to a high temperature in tropical climates is a powerful cause of hepatic derangement and disease, particularly if accompanied with too free indulgence in alcoholic stimulants. 7. Diseases of the liver may arise by extension from neighbouring structures; or by the convection of morbid materials from more or less distant parts. The latter may be best illustrated by pyæmia; and secondary affections of this kind are believed to be particularly frequent in the liver when the morbid products are conveyed directly from the alimentary tube, especially in connexion with ulceration, dysentery, or certain operations. 8. Obstruction to the circulation, due to some forms of cardiac disease, is an important cause of some hepatic affections. 9. Disorders of the liver are often attributed to various hygienic errors, exposure to cold, and other causes, but how far this conclusion is justified in particular cases is a matter of doubt.

Clinical Signs. — So far as the actual diseases of the liver are concerned, the clinical phenomena to be looked for and studied lie within a limited range, and may be grouped under the following heads: 1. *Morbid sensations*, referred to the hepatic region, or to the shoulder, such as pain of various kinds, tenderness, sense of weight, throbbing. 2. *Symptoms due to interference with the biliary functions*, particularly jaundice and its accompanying phenomena. 3. *Symptoms resulting from more or less obstruction to the portal circulation.* These include digestive disorders, due to congestion or catarrh of the mucous membrane lining the stomach and intestines; hæmorrhage from this membrane in some cases, leading to hæmatemesis and melæna; ascites, which is a most important symptom; enlargement of the spleen; hæmorrhoids; congestion of the womb in women, it is said; and, in certain conditions, dilatation of the veins of the abdominal wall. 4. *Symptoms produced by the pressure upon, or other interference with, neighbouring structures, of an enlarged liver.* Thus, the organ not uncommonly extends upwards, pushing up and limiting the movements of the diaphragm, and pressing upon the lung, hence causing dyspnœa. Or it may compress vessels and other structures; or in some cases it even interferes with the heart's movements. 5. *Physical signs.* These indicate enlargement or contraction of the liver; changes in situation or shape; changes in physical characters; and rarely pulsation. 6. *General symptoms.* These may be more or less independent of the hepatic disease, this being merely a part of a general malady; or the liver-affection may give rise to pyrexia, wasting, and other symptoms affecting the system at large. The absence of any such phenomena is important in the diagnosis of certain affections of the liver. Hepatic derangements are supposed to originate many general and remote symptoms, not obviously connected with this organ; and some authorities attach much importance to these disorders in the development of lithæmia and gout. *See* Gout.

The individual diseases of the liver will now be discussed in alphabetical order.

Frederick T. Roberts.

LIVER, Abscess of.—Synon.: Hepatic Abscess; Fr. *Abcès du Foie*; Ger. *Leberabscess.*

Abscesses of the liver are divisible into two classes: (1) tropical abscess; (2) other forms of abscess, including those resulting from the following morbid states: pyæmic conditions, especially such as arise from typhlitis and surgical operations or affections about the rectum; lobular hepatitis, as described by Sir Richard Quain (*Trans. Path. Soc. of Lond.* vol. iv. 1853); suppurating hydatid cysts and other parasites; forms of traumatism, especially blows on the liver; gall-stones; and pylephlebitis. The latter class fall to be considered under their appropriate heads. Here it may be remarked that, although their ætiology and pathology are widely different from those of tropical abscess, their diagnosis and treatment are practically the same. Tropical abscess, as its name implies, usually originates in tropical or subtropical climates; the other forms are not so restricted.

Tropical Abscess of the Liver.—Ætiology.—The association of abscess of the liver with dysentery has long been recognised, and the more the subject is investigated the more constant is this association found to be. So much is this the case that some recent writers incline to regard the terms 'tropical abscess' and 'dysenteric abscess' of the liver as synonymous. Without going quite this length, it may safely be asserted that in 75 per cent. of cases of hepatic abscess a history of some degree of dysentery—not necessarily of a very urgent character—can be elicited. It must be recognised, however, that in this association the order of events is not always the same: usually the dysentery is antecedent to the hepatitis; sometimes the diseases are coincident; more rarely the hepatitis precedes the dysentery; and in not a few cases the two conditions alternate. The advocates of the ætiological identity of the two diseases suggest that in a proportion of cases in which dysentery is not a feature either before, during, or after the occurrence of abscess, the pathological drama has not been played out. They argue that, just as dysentery may exist without hepatitis, hepatitis may exist without dysentery. Whatever may be the exact relationship between these diseases—a relationship succinctly expressed by the term 'hepatic dysentery,' devised by the clinical acumen of Annesley long before there was much theorising in the modern sense—it is certainly a very intimate one, and one which should always be borne in mind in the diagnosis of hepatic abscess, as well as in the prognosis of dysentery; and it should also be borne in mind that the abscess may not develop till months after the dysentery has been recovered from, and the patient perhaps has left the endemic area.

The most potent circumstance in predisposing to hepatic abscess is residence in a hot climate, more especially if the heat is combined with humidity and malaria. There are exceptions, but, speaking generally, liability to this form of abscess increases *pari passu* with these conditions. Intemperance in eating and drinking; lazy, luxurious habits; bad food; hardship and exposure, such as are incident to a soldier's life in time of war; hot, close, and overcrowded barracks; and unhygienic conditions in general have a marked though secondarily predisposing influence. Men are more subject to it than women, adults than youths; children seem to enjoy almost an absolute immunity. Race has undoubtedly some influence, but how it operates—whether in consequence of peculiarities of habit, acclimatisation, or specific racial idiosyncrasies—has not been adequately determined. It is certain that liver-abscess is much more common in Europeans frequenting hot climates than in the natives.

Among the circumstances which determine the formation of abscess in persons predisposed, either by dysenteric hepatitis, or by those subtle and as yet unformulated physio-pathological changes in the liver-tissue associated with life in the tropics, are, above all, chills of the surface such as arise from rapid alternations of heat and cold, from sitting in draughts in wet clothes, from bathing in cold water, or sleeping without adequate clothing. A blow on the liver, a bout of drinking, or a surfeit, is often the starting-point of the disease.

Anatomical Characters and Pathology.—Tropical abscess of the liver may be single or multiple, and it may vary in size from a minute collection of pus to an enormous sac containing many pounds of fluid, and occupying a large extent of the liver. When a section of a liver in an incipient state of suppuration is made, one or more circular patches, greyish-yellow or otherwise altered in colour, and surrounded by an area of congestion, are revealed. Abscess is formed by the breaking down of one of these patches, liquefaction commencing in the centre. Frequently two or more neighbouring patches coalesce. When the abscess has attained any size its walls are found to be very irregular, their inner surface being coated usually with a yellowish, tenacious purulent material lying on a thin zone of more or less infiltrated liver-tissue — the abscess sac—which in its turn is surrounded by a hyperæmic zone; beyond this the liver-tissue may be fairly healthy. Around and, so to speak, in the walls of the principal focus of suppuration a number of minute abscesses may form, and it is by the bursting of these into the main cavity, and the necrosis of pieces of intervening tissue, as well as by the slower process of purulent and molecular disintegration of its walls, that the cavity enlarges. The contents vary considerably: usually they are of a chocolate-brown colour, and have a thick, gummy consistence tending to become gelatinous on cooling. The odour too is peculiar. Not infrequently lumps of necrosed liver-tissue or clots of blood are found floating in the fluid, which may also be streaked with blood, bile, or a yellow, mucoid-looking pus of a paler colour. Occasionally the pus is more fluid, and may have the appearance of ordinary laudable pus; rarely it is thin, watery, or grumous. It frequently contains micro-organisms, but in not a few instances the bacteria of pus are absent. It is further characterised in a certain proportion of cases by the presence of a protozoic organism—the *amœba coli.* This parasite consists of a minute mass of plastic protoplasm, divisible into an imperfectly defined and granular endosarc, and a homogeneous and very pellucid ectosarc. At low temperatures the amœba ceases to move, and assumes a globular form, having a diameter equal to about that of three or four blood-corpuscles. At the temperature of the body it exhibits active and characteristic amœboid movements. It is readily detected by a magnifying power of from 80 to 100 diameters, especially if the amœboid movements are encouraged by slightly warming the slide. *See* ENTOZOA.

When the abscess is single its most usual situation is towards the back part of the right lobe, but it may occupy the left lobe or any other part of the gland. When abscesses are numerous, they are scattered throughout the liver, especially near the peritoneal surfaces.

Death may occur before the abscess ruptures; rarely it becomes encysted or absorbed; usually it makes its way to the surface of the organ and, after adhesions have been formed between opposing serous surfaces, opens on the surface of the body or into some of the neighbouring viscera. The most usual direction in which rupture occurs is into the right lung, next in frequency the intestinal tract, less frequently the surface of the body, and rarely into the pleural or peritoneal cavities or into the pericardium, gall-bladder, inferior vena cava, or calyx of the right kidney. Rupture into the pericardium or vena cava is necessarily and speedily fatal, but in a case recently recorded by Mr. Hulke recovery followed surgical interference after a hepatic abscess had opened into the peritoneum. Recovery may speedily ensue after rupture of the abscess, more especially if it opens into the lung or intestinal canal; but in this event, in the majority of instances, the necrotic process is not arrested, and the patient sinks after perhaps a long illness. Recovery after surgical operation, even in the case of very large abscess, is often remarkably rapid, a great cavity of many ounces capacity healing up perhaps in a week or two.

Of the intimate pathology of hepatic abscess little, if anything, is known. By the discovery of the amœba coli in connexion with this disease and dysentery, the question seems to have entered on a promising field. Kartulis, and more recently Osler, Councilman, and Lafleur have shown that this parasite is present in a form of dysentery, characterised by its peculiar obstinacy and tendency to relapse, and which has been named *amœbic dysentery.* Moreover, the latter observers have shown that the amœba not only occurs in the dysenteric and hepatic discharges, but also penetrates deep into the bases of the dysenteric ulcers, and into the tissues surrounding hepatic abscess. These circumstances, to say the least, are significant. Moreover, the amœba has been found in dysentery and in liver-abscess in India (Hehir), in Africa, in Europe, and in America. That it is not invariably pathogenic is proved by its being sometimes present in the healthy fæces of apparently healthy individuals, so that it has yet to be shown that it is the real cause of these diseases, and not merely an occasional epi-phenomenon.

With reference to the association of dysentery and hepatic abscess, it ought to be mentioned that in some epidemics of dysentery abscess is of more frequent occurrence than in others, and this has been remarked, not only in epidemics in the tropics, but in epidemics occurring in Europe. In many of the latter hepatic abscess is almost unknown, but in others it is not so rare, as in the Dublin epidemic of 1818. Manifestly there is a specific element common to certain types of dysentery and hepatic abscess: but what this is, and how it operates, has not been determined. At one time it was held that the abscess was caused by the absorption of pus by the portal vein from the dysenteric ulcers, and from suppurating phlebitis which was supposed to be present in the intestinal radicles of that vessel. But no such phlebitis was demonstrated; and, moreover, it was shown that the hepatitis may precede the dysentery, and therefore could not be caused by it. Further, as hepatic abscess is by no means a frequent sequela of gastric ulcer, of typhoid fever, or of tubercular or malignant ulceration of the intestine, the ulceration of the bowel in dysentery cannot *per se* be regarded as the cause of tropical abscess of the liver.

Symptoms.—Sometimes these are fairly acute, but in the great majority of cases they are of an extremely subdued and insidious character, so much so that sometimes the first intimation of the presence of abscess in the liver is its rupture into the lungs or intestine, and a discharge of the peculiar chocolate-coloured pus. Very often the symptoms amount to little more than feelings of ill-health, vague uneasiness about the region of the liver, and a state of low irregular feverishness. Temperature in the morning may be but slightly if at all above the normal, rising during the day to 101° or 102°; or there may be spells of complete apyrexia or, occasionally, of smart fever. Profuse sweating, particularly during sleep, is generally very marked. Slight feelings of chilliness occur from time to time, and in a few cases smart rigors are met with ; but too much importance must not be attached to their absence. The complexion may be muddy, and the scleræ slightly icteric; the urine, though often loaded and dark, is seldom icteric, and marked jaundice is rare. The temper is generally very irritable, and the spirits depressed. The tongue is sometimes coated; at other times it is clean. Appetite is usually poor; but occasionally it is fairly good. Vomiting may occur, especially if the left lobe of the liver is involved. The bowels may be confined ; generally they are loose or irregular, often dysenteric. A short dry cough and some dyspnœa are not uncommon. The decubitus is usually dorsal or on the right side. In some cases pain of a cutting character in the region of the liver is a distressing symptom, and is regarded as evidence of perihepatitis, and the formation of adhesions between the peritoneal surfaces. In other cases the pain is of a very subdued type—more a sense of weight and uneasiness; but it is usually intensified by pressure or percussion or smart compression, and it is often observed that percussion over the lower part of the abdomen may cause pain not where the blow falls, but in the region of the liver. Firm pressure on the liver often gives rise to a feeling of nausea or faintness. Pain in the right shoulder or scapula is one of the classic symptoms of hepatic abscess, and is regarded as an indication that the mischief is in the neighbourhood of the diaphragm. The abdomen is generally on inspection seen to be motionless and full. The liver is enlarged, but not always to a great extent; the enlargement may be upwards, a more significant sign than when it is enlarged in a downward direction. There may be a general bulging of the right hypochondrium, and obliteration of some part of one or two intercostal spaces, with a degree of œdema or even redness of the integuments. In wasted patients with normal livers the epigastrium should be scaphoid when they are lying down, but in abscess of the liver it is often flat or even bulging, and this is more apparent when the patient is made to stand up; this appearance, with fever and tenderness, is always a suspicious symptom. Friction or crepitation may be heard at some part of the base of the right lung; the presence of these indicates proximity of the abscess to the diaphragm ; and if, in addition, the amœba coli is found in the sputum—as Councilman and Lafleur have pointed out—rupture of the abscess into the lung is impending. When this occurs, a thick, gummy, chocolate-brown pus—quite pathognomonic in appearance, and yielding the reactions of bile when tested chemically, and exhibiting granular and degenerated liver-cells under the microscope—is brought up. In consequence of the persistent coughing after the abscess has opened and partially emptied, there may be much hæmorrhage from its walls, and a very bloody sputum; so much so that the great bulk of the expectoration is blood, with here and there only a streak or pellet of the chocolate-brown pus. This appearance is very apt to deceive the unwary, and to lead to a diagnosis of pulmonary hæmoptysis. The stethoscope may detect approximately the point of entrance of the abscess into the lung, and occasionally it reveals peculiar and very loud bruits, synchronous with the pulse, somewhere about the upper border of the hepatic area, and sometimes of a to and fro character. These bruits probably arise from a to and fro play of air out of and into a partially empty but uncollapsed abscess-sac through a narrow sinus, and are produced by the jog communicated to the inflated abscess-sac by the systole of the ventricles. Should the abscess open into the bowel there may be one or two loose stools of a similar chocolate-brown character; and in a case of suspected abscess of the liver the physician ought always to bear this in mind, and inspect any loose motions reported to him. Rupture into the stomach may be followed by vomiting; if into the pericardium or peritoneum, by sudden collapse.

Diagnosis.—This is often a matter of great difficulty, even to the most experienced, and at times only to be settled by the development of events, or the use of the aspirator. An excellent rule for the practitioner in countries in which hepatic abscess is endemic is as follows: Whenever persistent ill-health is associated with a low degree of fever, and symptoms—no matter how trifling—referred to the abdomen, which cannot be readily accounted for, suspect abscess of the liver, and examine the organ daily with this possibility in view, and inquire carefully for a history of dysentery. It must be borne in mind, too, that the dysentery may have been very trifling, called perhaps diarrhœa, and that it may have occurred several months before the health began to break down. The significance of enlargement of the liver, localised hepatic swelling, pain, tenderness, a fixed and motionless abdomen, rigors, and a hectic temperature following dysentery can hardly be misunderstood. But it is seldom that in the early and more hopeful stages of abscess the indications are so unequivocal; indeed it may be, and often is, entirely overlooked, and not discovered until it has burst into lung or bowel, or until it is found on the *post-mortem* table. The presence of pneumonic crepitus about the base of the lung in liver cases is often misinterpreted; rightly understood, it is a most valuable confirmatory sign, especially if it is limited to a small patch. Sometimes the periodicity of the fever, and the severity of the rigors, and regular procession of pyrexia and diaphoresis in hepatic abscess, lead to a diagnosis of ague; but the impotence of quinine to cure the fever, and the absence of the plasmodium malariæ in the blood, and of splenic enlargement—which is nearly always present when the liver is affected in malarial hepatitis, and which rarely if ever ends in abscess (Kelsch and Kiener) — ought to awake suspicion. When in a malarial subject there is a history of dysentery, and both liver and spleen are enlarged, diagnosis in the early stage of hepatic abscess is nearly impossible without the aid of the aspirator. In any case where grave doubt exists, where fever is persisting, and the patient is manifestly losing ground, exploration with a medium-sized aspirator-needle must not be delayed. This trifling operation, if attended with any risk, is infinitely less dangerous than procrastination. With proper precautions it is not a dangerous proceeding; so far from doing harm it has often a markedly curative effect in cases of hepatitis, even when there is well-marked local bulging. As an encouragement to early recourse to the aspirating needle, it ought to be borne in mind that hectic may occur in hepatitis before the formation of pus, and even in cases in which pus never does form; and the whole trouble which otherwise might have ended in abscess may rapidly subside after exploratory needling. In exploring the liver with the aspirator, in the absence of definite localising indications, the needle ought to be entered in the first instance about the seventh or eighth interspace in the anterior axillary line; if pus is not found here, a second and third puncture should be made, the needle being driven in to its full extent if necessary, in front just below the ribs a little to the inside of the nipple-line, and again behind in a line with the angle of the scapula well below the edge of the lung.

Prognosis.—It is impossible in the present state of medical knowledge to say how dysenteric hepatitis may terminate, whether in resolution or abscess. Should the latter form, provided it is single and opened soon and effectually drained, the prognosis is fairly good; quite 50 per cent. recover. If left too long or allowed to open of itself, the prognosis is bad, though by no means hopeless. If two or more abscesses are present, the chances of recovery are proportionately diminished; and if there are many suppurating points scattered through the liver, death is inevitable. If after operation the temperature quickly becomes normal and keeps so, prognosis is favourable; but if, on the other hand, after operation there is a distinct evening rise and a continuance of the hectic, the worst may be apprehended.

Treatment. — Hepatitis threatening abscess ought to be treated by absolute rest in bed, low diet, and, in the absence of diarrhœa or dysentery, saline aperients, such as sulphate of sodium. The right side ought to be covered with a large, hot, frequently renewed poultice, a foot in breadth and three feet in length, and which should pass from beyond the middle line behind to beyond the middle line in front. If there is dysentery, a thirty-grain dose of ipecacuanha should be given, and repeated as in ordinary dysentery (*see* Dysentery). In the absence of intestinal trouble, chloride of ammonium in twenty-grain doses every six hours is sometimes exhibited with advantage. Quinine is indicated in malarial complications.

Symptoms not improving, exploration with the aspirator must not be too long delayed. If pus is found, the abscess should be opened forthwith, thoroughly drained, and treated on Listerian principles. The different methods of operating do not fall to be considered here, but it may be remarked that in no surgical affection is it more necessary to observe the grand surgical principles of early opening, free drainage, and perfect asepsis. By these means of late years the mortality in this affection has been enormously reduced, and a diagnosis of liver-abscess is now no longer to be regarded, as it was in former days, as almost tantamount to sentence of death. The opinion of the physician is sometimes asked as to the propriety of making an external opening, in the case of an abscess discharging through the lungs or intestinal canal, or from an inefficient sinus in the walls of the chest or abdomen. A good rule to observe in such a case is this: If the patient is improving, fever absent, and discharge lessening, do not counsel interference; if, on the other hand, hectic persists, the discharge increases or does not diminish materially, and the patient continues to lose ground, advise operation. If there be doubt about which course to advise, recommend change of air, which has sometimes a wonderful influence in wavering cases in inducing healing. Should fever and ill-health persist after the abscess has been freely drained, and the drain, though effective, give vent to very little discharge, suspect the presence of a second abscess, and advise further exploration, and—if pus is found—further operation. Recovery has followed after several abscesses have been so treated in the same individual. If the temperature keeps up after all abscesses have been opened, and discharge from the drainage tube is profuse, it is an indication that the necrotic process is still going on in the liver; the prognosis is then most unfavourable. Gangrene sometimes sets in around the operation-wound, and is almost invariably fatal.

When pus has formed, the diet ought to be fairly liberal; but overfeeding and over-stimulation are under all circumstances to be carefully avoided.

Patrick Manson.

LIVER, Albuminoid Disease of.

Synon.: Waxy Liver; Lardaceous Liver; Fr. *Dégénérescence Amyloïde du Foie*; Ger. *Amyloide Entartung der Leber.*

Definition.—A disease characterised by painless, more or less considerable, enlargement of the liver; due to the existence in its structure of a peculiar homogeneous substance, the exact nature of which is not known, but which has a marked relation to certain cachexias and constitutional maladies.

Ætiology.—Albuminoid disease of the liver occurs in association with constitutional syphilis and diseases attended with protracted suppuration, or other protracted exhausting discharges. It has occasionally been found with chronic bone-disease, more especially of the spine, without evidence of any adequate discharge; and it is known to occur occasionally in new-growths, more particularly in the liver. It has been noticed in connexion with chronic dysentery, but the records of the Seamen's Hospital do not confirm such association. In many cases of chronic ague, with marked cachexia, which have been admitted into the hospital just named, there was an enlarged hard liver, pointing to albuminoid change; but there was probably in these cases the superaddition of syphilitic taint. Rokitansky speaks of the disease as congenital in children born of syphilitic parents.

Anatomical Characters.—The liver has its normal shape; is more or less enlarged, sometimes to such an extent as to fill the greater part of the abdominal cavity; and is firm, resistant, and inelastic, with a smooth, glistening surface. The organ cuts like bacon, hence the name 'lardaceous.' The cut surface is a translucent grey, like gelatine or boiled sago, or, in advanced cases, a peculiar subdued red, like that of raw ham; but sometimes it is yellowish or speckled, the liver being anæmic and often fatty also. From the incised veins a little pale blood usually oozes. The application of solution of iodine to the cut surface causes change of colour, which has been described as reddish-brown, mahogany-brown, or walnut, by different observers. For microscopical examination, a weak solution of methyl-aniline violet is at once delicate and distinctive. Supposing a lobule of the liver to be divided into three zones, the characteristic iodine or other stain will be seen, in less advanced stages of the disease, to be limited to the middle zone, where the hepatic artery is distributed; the vessels and cells here being filled with the new material, which afterwards may extend so as to implicate the entire lobule. The structures invaded by the new material have, in a section examined microscopically, a lustrous, transparent, and somewhat swollen appearance. When the entire lobule is affected, the aspect is homogeneous. The appearance of an albuminoid liver may be modified by the co-existence of fatty change, or cirrhosis, or syphilitic disease. The spleen is generally, and the kidneys are not infrequently, implicated.

Symptoms.—Palpation, in marked cases of albuminoid disease of the liver, will readily detect a large, hard, resistant tumour, having the normal outlines of this organ; the smoothness of its surface; and the extent to which it encroaches upon the abdominal cavity. Pressure does not elicit any tenderness, nor is there usually any pain; at most, in advanced cases, there is only a sense of tension and fulness, as in other hepatic enlargements. The painless nature of the tumour is distinctive. The disease does not interfere with the portal circulation, and does not therefore directly cause ascites. When this occurs, it is the result of general cachexia, induced by the constitutional malady, and perhaps by associated renal complication. The dropsy generally affects the legs in the first instance, and afterwards the serous cavities, and is not a prominent symptom unless the kidneys are implicated. In this case the urine is usually of low specific gravity and albuminous, and the anæmia very marked. The system of bile-ducts not being obstructed by the disease, there is no jaundice; or if this occur, which is a rare event, it is from pressure on the duct externally by enlarged lymphatic glands. The evacuations are, however, frequently of a pale yellow, and at times of a clayey, colour, which may be accounted for by the extensive impairment of secreting structure, and the consequent secretion of a poor, colourless bile. A lardaceous state of the spleen is a frequent accompaniment of the liver affection, and gives rise to increased volume and hardness of the organ. Vomiting, without the usual indications of gastric derangement, such as furred tongue, and diarrhœa, are symptoms not uncommon in advanced cases, and are due, according to Frerichs, to the implication in the disease of the vessels and villi of the stomach and intestines.

Diagnosis.—The peculiar features of the enlargement, its painless character, the concurrence of the constitutional maladies already noticed, especially if with implication of spleen and kidneys, will distinguish an albuminoid liver from other kinds of hepatic enlargement. If there be associated cirrhosis or syphilitic disease, the diagnosis will be difficult; but, as Bamberger remarks, an error will not be of moment as regards prognosis and treatment.

Prognosis and Duration.—The disease may run on for months or even years, but it generally proves fatal, either by intercurrent affections, or by anæmia, general dropsy, and exhaustion, such result being more rapidly determined when the kidneys involved.

Treatment.—It is more than probable from the records of cases of late years, that if the discharge which produces it can be arrested—by the removal of diseased bone, for example, or the limb in cases of joint-disease—the abnormal product in lardaceous disease may be re-absorbed and the disease cured. Surgical measures, therefore, directed towards the closing of sinuses, or the stoppage of any discharge that may be present, are of the first importance. But there are many cases—in advanced phthisis, for example, where the position of the disease is a bar to treatment, or in syphilis, in which we are as yet quite in ignorance of the reason of the production of the morbid deposit—where the only treatment that can avail must be directed especially to the associated cachexia. Whether this be syphilitic or strumous, the preparations of iodine are indicated: the iodide of potassium, the tincture of iodine, or, where the anæmia is marked, iodine in combination with iron. The syrup of iodide of iron in drachm doses, three times a day, has proved useful, if not in reducing the tumour, at least in improving the general condition of the patient. The iodine mineral springs, as Woodhall Spa, Kreuznach, Adelheidsquelle, &c., are indicated, although they contain but infinitesimal doses of iodine and bromine. The baths of Aix-la-Chapelle, Ems, and Weilbach have each had its supporters in the treatment of this malady. Chloride of ammonium, in ten to twenty grain doses, three times a day, continued for some time, has been found to be efficacious in reducing large hard livers (Budd, Begbie, Stewart). The general therapeutical indications are pure air; plain nourishing diet; the regulated use of alcoholic stimulants; and adequate protection of the skin by warm clothing and other measures.

Stephen H. Ward. James F. Goodhart.

LIVER, Apoplexy of.—By this is meant hæmorrhage into the liver, in the form either of isolated patches of extravasation or of general effusion, the whole of the hepatic parenchyma being converted into a dark-red pulpy mass. This affection is rarely met with in this country, but has been often observed abroad in warm climates and malarious districts, as a result of disease of the liver, or prolonged and intense congestion. It occurs also in some cases of scurvy. Abercrombie believed that the puerperal condition predisposed to hepatic apoplexy. It has been observed also, according to Frerichs, in some new-born infants after long labours, and in cases of this kind it is usually associated with pulmonary atelectasis. A rapidly fatal case of hepatic apoplexy was reported by Andral, in which there were no indications of any efficient cause of the hæmorrhage (*Clin. Med.*, 3rd ed. t. ii. p. 259). Extravasation of blood into the substance of the liver, together with a pulpy condition of more or less of the parenchyma, may be produced by the application of violence to the hepatic region.

Symptoms.—The symptoms that have been observed in cases of hepatic apoplexy are pain in the right hypochondriac region, and excessive tenderness; jaundice; bilious vomiting; melæna; a cold and bloodless condition of the skin of the face and limbs; and in some cases syncope.

This affection is almost invariably fatal when associated with previous disease of the liver, or with extensive laceration.

W. Johnson Smith.

LIVER, Atrophy of, Acute Yellow. Synon.: Fr. *Atrophie Jaune Aiguë du Foie*; *Ictère Grave*; Ger. *Acute Atrophie der Leber.*

Definition.—This is a general disease, likened by Trousseau to a pyrexia. The jaundice, being so prominent a symptom, formerly drew attention too exclusively to the liver; but the same degeneration which seizes upon the liver, likewise attacks all the glandular and muscular organs of the body. The morbid change is a parenchymatous degeneration, called by Virchow and his school a parenchymatous inflammation. It consists in a filling of the cells of a gland with albuminous granules, in such numbers as altogether to hide the nucleus; the albuminous granules quickly degenerate into oily particles and drops. These morbid appearances are found in poisoning by phosphorus, arsenic, antimony, alcohol, and other agents, and in all fevers, though in a less degree than in acute yellow atrophy. Buhl was the first to point out that the pyrexial changes were the beginnings of acute yellow atrophy.

Ætiology.—Acute yellow atrophy is perhaps the rarest of all the diseases occurring in this climate. Of its causes, next to nothing is known. It seems to be more common in women than in men; and in pregnant women than in others.

It has been shown that in pregnant and suckling quadrupeds and laying hens, the liver and kidneys often show cells infiltrated with fat, a fact which may throw some light on the disposition of pregnant women to acute yellow atrophy. Emotional disturbances, such as grief and trouble, and bad hygienic conditions, have been thought by some to predispose to this disease. It is occasionally induced by alcoholism, and may supervene upon cirrhosis. Some believe that all cases may be traced to phosphorus-poisoning.

Anatomical Characters.—After death it is not uncommon to find the liver of natural size, or even enlarged, in the early stages of acute atrophy. Later on, the organ shrinks, so that in extreme cases it may weigh as little as nineteen ounces; or even only thirteen ounces, as in the case of a girl of seventeen, recorded by Clements. It decreases in all diameters, but the left lobe is especially shrunken. The capsule is often wrinkled. On section, there is no longer any appearance of lobules, but an ochre-coloured surface without definite structure, often interspersed with reddened patches. The gall-bladder and bile-ducts are either empty or contain a grey mucus. The yellow and red appearances are blended. The yellow represents the early and acute stage of the disease, and is therefore mostly present in acute cases; the red represents the later changes, in which most of the liver-cells have disappeared, the colour being partly due to distension of blood-vessels. Under the microscope, the liver-cells are found, in the early stages, to be filled with granules, which completely hide the nucleus ('cloudy swelling'); part of these granules are soluble in acetic acid, others are not. Reddish-brown rhombic crystals, resembling hæmatoidin, have been described by Dr. Coats, amongst the detritus of the liver-cells, as well as crystals of leucin and tyrosin, which have been found by most observers, especially when the liver has been kept for some time. Later on, all trace of liver-cells may be lost, nothing but a granular and oily detritus and pigment being seen under the microscope, whilst the portal canals contain a greater or less number of migratory cells.

Micrococci have been observed in the liver by Waldeyer, Klebs, and Eppinger, but their pathological significance is doubtful.

The spleen is enlarged and soft in the great majority of cases. The stomach and alimentary canal present dark-red or tarry contents, the outcome of hæmorrhage; the tubular glands of the stomach are filled with fattily degenerated epithelium. The muscular tissue of the heart shows likewise fatty degeneration; and the tubules of the kidneys are filled with epithelium in various stages of fatty degeneration.

Symptoms.—Acute yellow atrophy is commonly preceded for some days or weeks by a simple jaundice, in which nothing peculiar can be made out. Delirium and convulsions then suddenly set in, followed by deep coma, stertorous breathing, and dilated pupils. During the first part of the disease the pulse is natural or reduced in frequency, but with the appearance of the convulsions and delirium it rises to 120 or 130. The skin is always yellow, rarely deeply coloured. The urine is natural in quantity, bilious, containing leucin and tyrosin; towards the end of the disorder it also contains no urea, chlorides, or phosphatic earthy salts; a kind of peptone is present. In some cases it is necessary to evaporate the urine to a concentrated condition to detect the crystals of leucin and tyrosin (*see* Leucin; and Tyrosin). There is almost always constipation; the stools being at first pale, afterwards black from admixture of blood. Vomiting is very constantly present; at the end of the disease, of a black coffee-ground matter. The right hypochondriac and epigastric regions are painful and tender. The liver, at first natural in size, or even larger than natural, decreases daily in dimensions, so that at last percussion may give no liver-dulness at all, owing to the softened condition of the liver causing it to become folded on itself, the intestines rising up to take its place. With the decrease of the liver, the spleen increases in size. A hæmorrhagic diathesis likewise sets in, as shown by petechiæ on the skin, epistaxis, hæmatemesis, and melæna. The temperature is commonly low, until just before death.

Diagnosis.—The diagnosis of acute yellow atrophy is very difficult, and may remain doubtful after death. The rapid shrinking of the liver, as evidenced by diminution of the hepatic dulness, associated with the discovery of leucin and tyrosin in the urine, the occurrence of grave cerebral symptoms, and the absence of pyrexia, are certain symptoms of acute atrophy. Poisoning by phosphorus can hardly be distinguished from acute yellow atrophy, unless the patient own to having taken the drug. The prodromal stage cannot be distinguished from simple jaundice.

Prognosis.—The prognosis is extremely bad: only a very few suspected cases are known to have recovered.

Treatment.—The treatment must be conducted upon general principles. A few cases, in which the diagnosis of acute yellow atrophy has been thought justifiable, have recovered, and these have been treated with the mineral acids and saline purgatives, aconite, quinine, and camphor. These are therefore the remedies which may be recommended to be used. Local symptoms, such as vomiting or bleeding, must be treated as in other diseases.

J. WICKHAM LEGG. STEPHEN MACKENZIE.

LIVER, Atrophy of, Chronic.—Chronic atrophy of the liver is seen in many wasting diseases, and in old age; the liver then often shrinks, becoming tougher in consistence, but rarely granular on the surface. The cut surface is dark red or pale brown; the acini are either invisible, or else smaller than natural. Frerichs thinks that the blood-vessels are all dilated. The increased toughness seems due to the atrophy of the liver-cells, the meshes of the connective-tissue network being thus brought nearer to each other.

The symptoms of chronic atrophy are merged in those of the primary disease, against which treatment must be directed.

J. WICKHAM LEGG. STEPHEN MACKENZIE.

LIVER, Biliary Accumulation in.—ANATOMICAL CHARACTERS.—When a permanent obstruction to the flow of bile into the duodenum has been set up, serious changes take place in the gall-ducts and the liver itself (*see* GALL-BLADDER AND GALL-DUCTS, Diseases of). At first the liver swells, apparently from the pent-up secretion. It becomes of a deep bilious or olive-green colour, the central parts of the acini being the deeper coloured; on section the dilated ducts are seen, and bile or a colourless fluid wells out of them. Increase in the consistence of the liver commences; and if the obstruction continue, the organ wastes, becomes much tougher, and shows a granular surface. This increase in consistence is due to an overgrowth of the connective tissue of the liver, as in cirrhosis, only to a less degree. The amount of overgrowth depends upon the kind of obstruction. It is greater when a rough angular gall-stone is the cause, than when a hydatid tumour with its smooth walls presses upon the gall-ducts. This overgrowth springs at first from the gall-ducts, which are greatly thickened, and thence spreads over the connective tissue of the portal canals.

The liver-cells atrophy, as in cirrhosis. They vary much in size. Their contents seem to be chiefly fat and pigment-granules, though neither is of very great amount as a rule. The arrangement in rays around the hepatic venule is quite lost. One of the most important functions of the liver is the preparation of glycogen, and this function seems to be abolished in long-continued jaundice. In animals whose bile-ducts were tied, Dr. Wickham Legg found the glycogen to disappear not many hours after the ligature was applied; and after puncture of the fourth ventricle, no sugar appeared in the urine.

In some cases of complete obstruction to the bile-ducts, the liver-cells have been found altogether destroyed, nothing but a fatty detritus being seen under the microscope. This is not owing simply to *post-mortem* changes in the liver; but is possibly due to the long-continued action of the bile-acids circulating in the blood upon the liver-cells themselves, as Leyden has pointed out. It is not owing to the simple solution of the liver-cells in the bile, for the bile has not the power of dissolving these cells, as Th. von Dusch has asserted. In some cases suppuration takes place in and around the bile-ducts—suppurative cholangitis.

SYMPTOMS.—As regards the clinical phenomena of biliary accumulation in the liver, there are, of course, all the symptoms of jaundice and of the disease which leads to it. In addition, the liver at first swells, and may be detected below the ribs for two or three fingers' breadth, but rarely more; it is often painful on palpation. Later on, the liver retreats within the boundaries of the chest. Ascites sometimes shows itself, owing to the disturbance of the circulation in the liver; and the spleen often swells. Fever of an intermittent or remittent character sometimes takes place, associated, it may be, with recurring rigors, which may simulate ague. The long precedence and persistence of jaundice, with, in many cases, history or evidence of the cause of obstruction, enable it to be distinguished from ague. All these symptoms are, however, liable to be interfered with by the primary disease.

TREATMENT.—The treatment must be directed to the cause of the obstruction of the ducts.

J. WICKHAM LEGG. STEPHEN MACKENZIE.

LIVER, Cirrhosis of.—SYNON.: Granular Liver; Hob-nailed Liver; Gin-drinker's Liver; Interstitial Hepatitis; Fr. *Cirrhose du Foie*; Ger. *Chronische interstitielle Leberentzündung*.

DEFINITION.—A chronic disease of the liver, in which the organ becomes hardened, and usually more or less diminished in size, at the same time assuming a granular or hob-nailed appearance; these changes resulting from an increase in the connective tissue, usually caused by abuse of spirituous liquors. The name *cirrhosis* was first given by Laennec to the hardened and shrunken liver, on account of the yellow colour of the granulations in this disease.

ÆTIOLOGY.—The most common cause of cirrhosis is, undoubtedly, the abuse of spirituous liquors. Spirits, unmixed with water, seem to be more potent in causing cirrhosis than wine or malt liquors. Next after these, but at a great distance, come syphilis, and the immoderate use, it is said, of spices—

such as curry, pickles, and powerful sauces, or of coffee. In some rare cases no cause is apparent. The fact of its occurrence in cases (rare it is true) where there have been no alcoholic excesses, and the negative results of experimental attempts to produce the disease in animals by long-continued administration of alcohol, raise the question whether when due to alcohol it is referable to the action of it *per se* on the liver, or to its indirect effects on the intestine, &c. The late Dr. Moxon suggested that in non-alcoholic cases it might be due to extension of inflammation from the peritoneum; and since then Dr. Goodhart, Sabourin, and Brieger have recorded its occurrence in tubercular peritonitis. The disease is far more common among men than women; it is very rare indeed in children. In some of the latter cases, the child has been proved to have been in the habit of drinking spirits. Cirrhosis has also been seen among the lower animals, a proof that alcohol is not the sole cause.

ANATOMICAL CHARACTERS.—The seat of the disease in cirrhosis is the capsule of Glisson. The connective tissue, which accompanies the vessels entering at the portal fissure, and which forms a covering for the liver beneath the peritoneum, takes on a very active overgrowth. One result of this overgrowth is compression and atrophy of the secreting cells of the liver. Another is a hindrance to the flow of blood through the liver; for, although new vessels do indeed form in the new connective tissue, yet these are by no means enough to carry on the circulation, in the place of those obliterated or destroyed by the advancing overgrowth of connective tissue.

There are several varieties of cirrhosis. In the first, the *atrophic*—that which is most common—the liver is shrunken, it may be to one-half or one-third of its natural size. This shrinking is often greatest in the left lobe, so that this may become a mere appendage to the right. At the sharp edge of the liver, there is often nothing left but a semi-transparent tissue, containing none of the elements of the gland. False membranes often join the surface of the liver with the diaphragm or other neighbouring parts. The surface itself is greatly roughened. It shows numberless granulations, varying in size from a poppy-seed to a hazel-nut. The fibrous investment of the liver is greatly thickened; and the peritoneum either tears off in layers, or leaves a granular surface behind. The liver is exceedingly hard and tough; and on section, the cut surface is seen to be made up of yellow islets, imbedded in a white translucent tissue. These yellow bodies are the representatives of the granulations seen on the outer surface, and they are the remains of the natural liver-tissue, separated from one another by the new white connective tissue.

This is by far the commonest variety of cirrhosis, but there are others. One form is *hypertrophic* cirrhosis, in which the liver is greatly increased in size, sometimes being more than double its natural weight; but the surface is smooth, and the capsule, though thickened, leaves a smooth surface when torn off. There is toughening of the liver, though not to so great a degree, and the same appearance of the cut surface as in ordinary cirrhosis. In another variety the organ is shrunken, but the surface is smooth, and on section are seen only pins'-points of yellow tissue in the white translucent overgrowth. Whether the hypertrophic variety ever becomes shrunken is still undecided. A third variety is *fatty* cirrhosis, which may be mistaken at first sight for fatty liver. but the touch shows how tough it is. It sometimes floats in water. There is no everted edge, and on section no acini are to be made out; but the cut surface is indistinct, pale, and yellow. The surface of the liver is smooth.

Under the microscope, using a low power, the tissue of the cirrhosed liver is seen to be broken up into islets, separated by broad bands of what looks like a highly nucleated connective tissue. The separation between the two appears sharply defined. In some cases the liver-cells may be seen infiltrated with fat. With higher powers. the most striking object in the field is the great abundance of what were once called nuclei, but now lymphatic corpuscles, in the new-formed connective tissue: these vary little in size or shape, nearly all being round or roundish. The prevailing opinion now is that they are emigrated leucocytes. They are arranged sometimes in clusters, sometimes in lines, and sometimes indefinitely. According to the arrangement of the cellular infiltration, the cirrhosis is said to be multilobular or extralobular; or insular, pericellular or intralobular. It is stated by some writers that in the atrophic form the cellular infiltration is multilobular, and in the hypertrophic unilobular or pericellular; but whilst this may be partially true, in both forms instances of both multilobular and pericellular infiltration are usually encountered. The origin of the clusters is uncertain; but it seems tolerably clear that the linear disposition arises from the obliteration of vessels carrying bile or blood. The connective tissue itself is highly fibrous; sometimes homogeneous or granular. The liver-cells themselves undergo great changes. They present fatty and pigmentary degeneration, lose their natural polyhedral shape, and become oblong, oval, or spindle-shaped. Between them the new connective tissue gradually insinuates itself, and the cells become lost in the advancing overgrowth. It is contended by Dr. Beale and Dr. Payne that the process commences in the liver-cells. These changes in the liver-cells are of course best seen at the spot where the liver-tissue and the connective tissue join. In rare cases acute yellow or red atrophy supervenes. In some cases—especially it is stated in cases of hypertrophic cirrhosis—linear rows of cubical cells are found in the portal canals. These are regarded by some as newly developed biliary canaliculi, by others as degenerated liver-cells.

Symptoms.—The first approaches of cirrhosis of the liver are commonly very insidious. Often one of the earliest symptoms is a dull pain in the neighbourhood of the liver. This is accompanied by signs of chronic gastric catarrh, of which morning sickness is, for the diagnosis of intemperance, of the greatest importance. Morning diarrhœa is sometimes an early symptom. The patients are commonly of a sallow, often almost jaundiced, complexion; at the same time the venules of the face are often distended and varicose, giving the patients' complexion a colour which to uneducated eyes is indicative of health. They grow thinner, and their strength fails. Some patients suffer from piles; in others diarrhœa occurs. Later on, the belly begins to swell, and ascites appears; the legs may become œdematous, from the pressure of the fluid in the belly on the anterior wall of the inferior vena cava. The urine is high-coloured; often deposits urates; and sometimes contains albumen, from pressure of the ascites on the renal veins, or from contracted kidneys.

An important point in the diagnosis is to determine whether the liver is of small size, and growing smaller. This is often difficult, on account of the ascites; the difficulty may sometimes be overcome by laying the patient on his left side. In the earlier stages the hard edge of the liver may at times be felt, and even though the ascites be great, by suddenly depressing the walls of the belly with the fingers. The percussion-dulness of the liver in the nipple-line may be reduced to two inches or even one inch in height.

Although in the new-formed connective tissue of cirrhosis fresh vessels form to take the place of those obliterated, yet these by no means suffice to carry on the circulation through the liver. Portal obstruction therefore arises, which relieves itself in various ways: most commonly fluid is poured out into the cavity of the peritoneum, causing an ascites, or into the cavity of the intestines, causing a diarrhœa, which should not be lightly checked. In other cases it is relieved by hæmatemesis, or by hæmorrhoidal discharge. That which is most fortunate for the patient is the formation of a varicose communication between some radicles of the portal system and the general veins; as between the hæmorrhoidal and the hypogastric, the veins of the stomach and the œsophageal. Most important of all, however, is a vein discovered by Sappey. It arises from the left branch of the portal vein, and passes up the falciform ligament close to the ligamentum teres to join the epigastric and internal mammary veins. It is by no means the same as the old obliterated umbilical vein, although so near to it. The vein just mentioned will often be found dilated after death.

As a rule the spleen is enlarged in cirrhosis. The enlargement may be very great, but the organ is commonly about twice or three times the natural size. After death the spleen is found of softer consistence than natural, sometimes pulpy. The cause is obscure; the reason commonly given is the hindrance to the flow of blood through the liver acting on the splenic vein. The spleen, however, does not always swell when there is obstruction to the portal circulation—for example, in nutmeg liver.

Ascites is a symptom which sooner or later is sure to come on, but extreme cirrhosis may be present without ascites. It appears to arise from the venous stasis in the subperitoneal tissues. Fluctuation, and the movement of the fluid on change of posture, are very clear. The fluid, like all other dropsical effusions, contains albumen, salts, sometimes urea, sometimes sugar; and in jaundice, bile-pigment. After the ascites has set in, the feet may begin to swell, from the pressure of the fluid on the vena cava. The upper limbs and face are free from œdema. In the hypertrophic form ascites is generally wanting, and the patient is deeply jaundiced. In some cases albumen is present in the urine, from coincident Bright's disease.

The patients often complain greatly of flatulence, which adds much to their distress, and dyspnœa. Hæmatemesis and piles are of frequent occurrence, and often epistaxis occurs. Diarrhœa when it comes is salutary, as above mentioned, and should not be checked unless extreme. The urine is scanty and high-coloured; often turbid from urates; and bile-pigment is present when jaundice sets in. Jaundice may or may not be seen, according as the pressure of the new connective tissue does or does not involve the bile-ducts. In the last stages there is great emaciation; stomatitis is often present; and in many cases a scorbutic condition of the gums and petechial hæmorrhages into the skin, especially of the lower extremities, occur. Sometimes the end is ushered in by cerebral symptoms; sometimes it is determined by hæmatemesis.

Diagnosis.—The diagnosis depends upon the history of intemperance; the size and consistence of the liver; the size of the spleen; and the appearance of ascites and other dropsies. Of importance also is the peculiar sallow earthy complexion; and the occurrence of hæmorrhages from the stomach or intestines. The diagnosis is often easy; while at other times it is very hard or well-nigh impossible to make. Cirrhosis may be confounded with portal thrombosis; obliteration of the hepatic duct; nutmeg liver; syphilitic disease, cancer, or hydatids of the liver; and with chronic peritonitis. The most frequent error made in diagnosis is that of mistaking syphilitic disease of the liver for cirrhosis. The former gives rise to portal obstruction and its effects, precisely as in cirrhosis. The only way to distinguish it from cirrhosis is by attention to the history of the case, and by careful examination for the signs of syphilis elsewhere, past or present. In hypertrophic cirrhosis, the coincident enlargement of the liver and jaundice often lead to the diagnosis of cancer of the liver. The absence of ascites is here important. When cancer presses on the common duct it nearly always compresses the portal vein, and ascites results.

Prognosis.—It is rare for a patient suffering from cirrhosis of the liver to live longer than one or two years after the symptoms have become so pronounced as to allow a diagnosis to be made, and many die within twelve months. Death is in nearly all cases the end of the disease.

Treatment.—In the early stages of cirrhosis it is most important to induce the patient to give up his habits of intemperance, for, without this, treatment will be of little avail. Next, the use of alkaline purgatives, with or without vegetable bitters, such as chiretta or calumba, will be very useful. A course of the waters of Carlsbad is often most useful, or of other alkaline or iodised waters. The diet must be mild, and a purely milk diet is sometimes of great service. Exercise on horseback or on foot should be recommended.

In the later stages of the disease the great object will be to keep up the strength of the patient. The ascites, which often becomes the patient's great trouble, sometimes entirely subsides when the patient is kept rigidly in bed without any medicine. When this fails, diuretics, especially copaiba, acid tartrate of potassium, digitalis and squills, and mercurial alteratives, may be employed. Paracentesis should be put off as long as possible, especially if the pulse is of good force, and the breathing not interfered with, as the end of the disease often arrives soon after the tapping, though in some cases the ascites is cured by this operation. Since the introduction of Southey's tubes, paracentesis has been deprived of many of its dangers, and certain physicians recommend early and repeated tapping. The flatulence should be combated by regulation of diet, charcoal, small doses of hydrochloric acid, and carminatives. The bowels must be kept open, but not severely acted on. *See* Ascites.

J. Wickham Legg. Stephen Mackenzie.

LIVER, Congestion of.—*See* Liver, Hyperæmia of.

LIVER, Contraction of.—A small liver is met with in cirrhosis, in syphilitic disease, in nutmeg-liver, and in long-continued obstruction to the gall-ducts, in all of which an overgrowth of the connective tissue of the capsule of Glisson is seen. Any kind of pressure on the liver from neighbouring organs will likewise beget wasting. A small liver is seen in old age, and in the marasmus of wasting diseases. The liver likewise wastes if the portal vein be obstructed, or the capillaries in the liver be obstructed, as in pigmented liver. A shrunken liver cannot be looked upon as a disease by itself.

J. Wickham Legg. Stephen Mackenzie.

LIVER, Enlargements of.—Anatomical Relations.—In proceeding to determine whether the liver is enlarged or not, the following points must be remembered. Normally, the dull sound yielded by percussion extends upwards in front, in a line drawn towards the nipple, to about the sixth rib; laterally, in the axillary region, to the eighth rib; and by the side of the spine, to the eleventh rib. The lower border of the liver corresponds in front and at the side to the lower border of the ribs; and the dulness behind merges into that caused by the right kidney. The left lobe of the liver extends across the epigastrium to the left of the mesial line; the dull sound caused by its upper border merging in that produced by the heart. The upper part of the convexity of the liver rises to a little more than an inch above the sixth rib, the lung dipping down in front, and giving rise to a modified percussion-sound; but for practical clinical investigation it is better to take the line of absolute dulness. The extent of the dull sound from above downwards in the right mammary line is nearly four inches, and at the side about four inches and a-half. In the middle line in front it extends from the base of the ensiform cartilage to about two fingers' breadth below its point. It should be remembered that the limits of the liver present, compatibly with health, considerable variation; that the organ is relatively larger in early than in adult life; that it is depressed in inspiration, and ascends in expiration; that it is somewhat lower down in the erect than in the recumbent position; and that there is temporary distension during digestion.

Diagnosis.—There are various sources of fallacy which may lead to an erroneous conclusion as to the size of the liver. Thus, an intestine distended with flatus may get in front of the anterior border of the organ, and lead to the supposition that there is contraction, when the contrary is the case. When there is ascites to any extent, it is difficult to make out the boundaries of the liver. In this case, however, by placing the patient on the left side, so as to let the fluid gravitate in this direction, a diagnosis may often be effected; also, by suddenly pressing the finger down below the ribs, and thus displacing the fluid, one may sometimes detect the enlarged organ. A rigid right rectus muscle is liable to be taken for a tumour; to obviate this source of fallacy the patient should lie on his back with his thighs drawn up, and his attention should be diverted by conversation whilst the examination is being made. Sources of fallacy may exist in the liver itself, as in malformations or malpositions of the organ; or they may be outside it, either in the abdomen or chest. Malignant disease of the stomach, omentum, or pancreas; a kidney greatly enlarged by cancerous deposit; or fæcal accumulations in the colon, may be mistaken for hepatic enlargement. The following considerations will assist in arriving at a correct diagnosis—(*a*) enlargements of the liver, however much they may extend beyond, generally occupy the normal site of the organ, and however irregular the surface, the usual outline may be traced; (*b*) such enlargements usually follow the movements of the diaphragm in full respiration. Effusion into the right pleura may be mistaken for enlarged liver, especially as this organ may be depressed by it, and so appear to extend beyond its limits in the downward as well as in the upward direction. In pleuritic effusion, however, the dulness on percussion will vary with the position of the patient, and the upper line of dulness will in effusion be straight, in hepatic enlargement convex. Pleuritic effusion and hepatic enlargement may, however, co-exist. Pneumothorax, emphysema of the right lung, thoracic tumours, and even extreme pericardial effusion, may depress the liver, and affect the diagnosis.

ENUMERATION.—Dr. Bright arranged enlargements of the liver under two heads, according to the surface of the organ, namely, smooth and irregular. Dr. Murchison considered this classification open to the objection that an enlargement, usually smooth, is at times irregular, and *vice versâ*, and he proposed the division into painless and painful enlargements; but similar objection may be taken to this.

The principal enlargements of the liver are associated with the following diseases of the organ: Hyperæmia or congestion; obstruction of the bile-ducts; abscess; hydatid disease; fatty infiltration; hypertrophic cirrhosis; albuminoid disease; malignant growths; syphilitic disease; and leucocythæmia. These morbid conditions of the liver will be found described under their respective headings.

STEPHEN H. WARD. JAMES F. GOODHART.

LIVER, Fatty Disease of.

DEFINITION.—A disease attended with painless enlargement, and diminished consistence of the liver; due to the presence of a large quantity of fat or oil in the secreting structure; and occurring in connexion with phthisis and other wasting diseases, or in persons of luxurious and indolent habits, in whom there is usually an abundant development of fat in the tissues and other organs.

ÆTIOLOGY.—Fatty liver may be due either to degeneration of cell-structure through faulty nutrition—*fatty degeneration*; or to infiltration of the cells with fat, transmitted through the portal vessels from without—*fatty infiltration.* Fatty degeneration is met with in association with other hepatic diseases, as albuminoid disease and cancer. The fatty liver which results from poisoning by phosphorus would, according to the experiments of Voit and Bauer, appear to be due to degeneration, as the dogs upon which they experimented had been kept without food previously, and were starved during the time phosphorus was administered; showing that the fat could not have come from other parts of the body, or been introduced in food, but must have resulted from the metamorphosis of tissue-material. It is with fatty infiltration that we are more particularly concerned. The fat may come either from within or from without the body. The former case is illustrated when the greater part of the fat of the tissues and organs is absorbed, as in the emaciation of advanced phthisis. Louis, who first established the association of fatty liver with phthisis, found it to exist in about one-third of the cases of this disease, and met with it much more frequently in phthisical females than in males. His observations have been amply confirmed by subsequent observers. Fatty infiltration of the liver also occurs in connexion with other wasting diseases, and is not infrequent in patients who have been long bedridden. From a therapeutical point of view, the medical practitioner is more interested in the disease under consideration, when fat is introduced from without the body. The affection of the liver is then associated with development of fat in other organs and in the tissues generally. Persons thus affected are usually given to undue indulgence in eating and drinking: to eating not only too much food, but food rich in oil and fat, and drinking beer, but especially spirits, to excess. Want of exercise of mind and body, a heated atmosphere, and general luxurious habits, materially assist in determining the affection. In illustration of this cause may be adduced the oft-cited experiments of Magendie, who induced very fatty livers in dogs by feeding them exclusively on butter; and also the production of the *foie gras* in geese, by penning them up in a heated atmosphere and cramming them.

Anatomical Characters.—In fatty disease the liver is more or less enlarged, but seldom to any great extent; the surface is smooth; the borders are rounded; the substance pits on pressure; and the organ is either of pale yellow or drab colour, or, when partially affected, has a mottled appearance. A portion placed in water floats, showing a diminished specific gravity. On cutting into the organ, the knife is greased; and a greasy stain is imparted to blotting-paper applied to the cut surface. A portion, when held in the flame of a lamp or candle, will burn when the water is driven off. It is, however, as Frerichs remarks, only by the microscope that the degree to which the liver is implicated can be determined. In slighter grades, fat-granules and globules are seen to be limited to the outer zone of the lobules in the vicinity of the portal vessels; but in advanced cases the whole of the cells will be found to be filled either with separate globules, or with a single large drop of fat. In less extensive infiltration the liver may marked by red spots, corresponding to the hepatic veins. Fat in limited quantity is always present in the human liver, so that the term 'fatty' can only be applied when it is in excess.

Symptoms.—In the lesser grades of fatty liver there are scarcely any distinctive symptoms, either objective or subjective. When the affection is more pronounced, percussion will indicate more or less enlargement, usually in the downward direction; and palpation may detect a rounded border and diminished consistence, and will, at any rate, determine that the organ is not unduly hard, has no irregularity of surface, and does not differ materially in shape from the healthy liver. There is seldom, if ever, any pain—at most, in marked cases, a sense of tension and of uneasiness on lying on the left side. Jaundice is a rare event; and ascites and enlargement of the spleen cannot be classed as symptoms of the disease. In cases of fatty infiltration, dependent on luxurious habits, as regards diet, &c., there is usually more or less development of fat in other organs, as well as in the omentum and subcutaneous cellular tissue. There is also a greasy condition of skin, with peculiar odour, resulting from abnormal oily secretion from the sebaceous follicles. Dr. Addison considered a peculiar condition of the skin—presenting to the eye a bloodless, almost semi-transparent, and waxy appearance, and to the touch a feeling of smoothness, looseness, and flabbiness—as indicative, if not pathognomonic, of fatty degeneration of the liver. In cases where the liver is much enlarged, and there is much abdominal fat, the upward pressure may interfere with the action of the diaphragm, and cause, especially after meals, embarrassment of breathing. The functional symptoms likely to be present in advanced cases are irregularity, generally sluggishness, of the bowels; more or less dyspepsia; and, perhaps, loss of appetite. In some cases a weak or irregular, or intermitting action of the heart with tendency to faintness or giddiness, points to implication of this organ, and is indicative of possible fatal consequences.

Diagnosis.—The enlargement of the liver, with preservation of its normal shape, without hardness or irregularity; the absence of pain, jaundice, ascites, or enlargement of the spleen; and its association either with the emaciation of phthisis or other wasting diseases, or with the habits of the gourmand and general development of fat in the body, will usually enable us to distinguish fatty from other hepatic diseases.

Prognosis.—The prognosis of fatty disease of the liver is affected by the associated general condition of the patient, and will, of course, be unfavourable in phthisis.

Treatment.—The general therapeutical indications in fatty liver resulting from luxurious habits of living, point to reform in the direction of diet, air, and exercise. Rich, oily, and fatty articles of food are to be avoided; whilst sugar and starch should be taken in moderation. Beer, in all forms, is objectionable, and so also is alcohol, unless well-diluted, and taken only at meals. Champagne is objectionable, but other light French wines are admissible. Exercise, either on foot or horseback, should be had recourse to daily, but must be regulated according to the soundness of the heart and circulation. Free exposure to pure air, and avoidance of heated rooms, are desirable. The functions of the skin must be promoted by adequate clothing, and by the use of the bath, or by sponging with soap and warm water. The bowels must be attended to, and dyspepsia met by antacids and vegetable bitters. The Carlsbad waters—the warm Sprudel especially—are indicated, being supposed to act upon the redundant fat.

Stephen H. Ward. James F. Goodhart.

LIVER, Functional Disorders of.—Introductory Remarks.—The importance of studying the functional disorders of the liver will be more fully appreciated if the intimate relations which this organ has to various functions of the body are understood. At one time, not very long since, it was supposed that the sole function of the liver was to secrete bile, chiefly for the purpose of eliminating certain objectionable materials from the system. It is now well recognised that other important and special functions are performed by this organ—an organ which is found to exist universally in one form or other throughout the animal kingdom. These functions were thus classified by the late Dr. Murchison, in his lectures on *Functional Derangements of the Liver*: (1) The formation of glycogen, which contributes to the maintenance of animal heat, and to the nutrition of the blood and tissues; (2) the destructive metamorphosis of albuminoid matter, and the formation of urea and other nitrogenous products, which are subsequently eliminated by the kidneys: these changes also maintaining the animal heat; (3) the secretion of bile, a large portion of which is reabsorbed, assisting in the assimilation of fat and other elements; whilst a part, passing downwards, stimulates the peristaltic action of the intestines, and arrests decomposition.

When it is remembered how the functions of the liver are readily influenced by various external and internal agencies, and how they are consequently deranged, it will be of the utmost importance to the pathologist and to the clinical physician to study the character and effects of these derangements. They were classified by Dr. Murchison under nine heads: (1) Abnormal nutrition; (2) abnormal elimination; (3) abnormal disintegration; (4) derangements of the organs of digestion; (5) derangements of the nervous system; (6) derangements of the organs of circulation; (7) derangements of the organs of respiration; (8) derangements of the urinary organs; (9) abnormal conditions of the skin. The above heads, however, represent for the most part functional and general symptoms resulting from hepatic disorders, rather than the disorders themselves. The arrangement under three heads, representing the three principal functions of the organ above mentioned, will be a sufficiently convenient form for the consideration of these disorders.

Ætiology.—It is scarcely necessary to remark that functional disorders of the liver are often secondary to or associated with disorder of its nervous and vascular systems, or with diseases of the thoracic and abdominal viscera, with febrile affections, malaria, and other causes. It is only with the causes which induce these disorders when primary that we are here concerned. They are—

1. *Errors in diet.*—The most common of these are habitual over-eating, and especially indulgence in fat and fatty articles of food, rich soups, entrées, and pastry; the undue use of sugar, or of fish or flesh containing much oily matter. Excess in the use of alcoholic drinks is another cause in frequent operation in this country. The combination of sugar with alcohol much enhances the mischief. Hot, sweet grog; sweet new wines; champagne, unless dry; Madeira; sherry; port-wine; Burgundy; liqueurs; the persistent use of malt liquors, particularly of mild ales and stout, are ready causes of hepatic derangement.

2. *Habits of life.* — Want of exercise, whether the result of necessity or of indolent habits, is a common exciting cause of hepatic functional disorders; and its effect is exaggerated when it is associated with errors in diet. Living habitually in a high temperature, whether in a warm climate or in overheated rooms, is another source of hepatic disorders, and this is intensified when in connexion with the causes already alluded to. Depressing worries, nervous and emotional influences, must not be forgotten in considering the ætiology of the subject. So likewise chills and exposure to draughts of cold air or to damp and wet.

Symptoms and Diagnosis.—The phenomena which are observed in functional derangements of the liver, and which give evidence of the presence of such disorders or derangements, may be in a great measure indicated according to the particular hepatic function which is affected, namely, (1) the *glycogenic*; (2) the *metabolic*, and (3) the *biliary*.

1. Disorders of the Glycogenic Function.—Disorders of this function of the liver, when persistent, come under the subject of diabetes, and require only to be mentioned here. *See* Diabetes Mellitus.

Sugar may also be found in the urine occasionally and in small quantities, in some cases in which its presence is clearly connected with disordered liver-function. It may be present with urea in excess, or with albumen, either at the same time or alternately.

2. Disorders of the Metabolic Function.—It is a matter of great practical importance to observe that the derangements of the metabolic function of the liver are constantly made evident and can be recognised by changes in the composition of the urine. These changes, therefore, should be looked for, and the urine of patients examined in almost every case. It is not possible here to describe all the changes in the composition of the urine which indicate functional disturbance of the liver. It will be sufficient to indicate the more important of these—(*a*) the lithates and lithic acid, (*b*) urea, (*c*) albumen, and (*d*) colouring matter.

(*a*) *Lithates and lithic acid.*—The writers quite concur with, and may concisely state, the views advanced on this subject by the late Dr. Murchison. One of the immediate results of such faulty function connected with albuminous disintegration is the non-conversion of nitrogenous matters into urea, and the production of lithates and lithic acid, inducing a condition of blood to which he fitly applied the term *lithæmia.* This lithæmia may be relieved for a time by elimination by the kidneys, showing itself in deposits in the urine, on cooling, of lithic acid, lithates, and pigmentary matter. These deposits are not infrequent in persons in apparently good health, especially after any excess or error in diet or exposure to cold; and they are more or less constant in subjects of gouty habit of body, and in those who are predisposed to hepatic derangement, or who induce it by habitual indulgence in over-stimulating diet. These deposits may continue for years without causing much discomfort; but after a time the excessive quantity of lithic acid and lithates cannot be eliminated by the kidneys; and they accumulate, causing disease of the kidneys as well as disturbances in different parts of the system, and giving rise to various more or less distressing symptoms. Of these symptoms the more prominent are—epigastric tenderness on pressure and sense of oppression, flatulent distension of stomach and bowels, heartburn, acid eructations, a sense of weariness and tendency to sleep after meals, furred tongue, unpleasant taste in the mouth, especially in the morning, appetite often good, sometimes the contrary, an excessive secretion of viscid mucus in the fauces and back of the nose, constipation and vitiated secretions. Palpitation, irregular or intermitting pulse, frontal headache, vertigo, deafness and noises in the ears, restlessness at night, irritability of temper, and hypochondriasis, are other symptoms that are more or less constantly present.

Gout, whether openly manifested, latent, or irregular, is associated with the symptoms just mentioned. It is one of the results of lithæmia, and thus has its origin very frequently in faulty hepatic function.

Urinary calculi are also a result of lithæmia, at all events those which consist of lithic acid or its salts, which, as we know, are the most frequent forms. Thus also it is that the formation of these calculi should be prevented by remedies and a *régime* directed to the liver rather than to the kidneys.

Biliary calculi are likewise a result of functional hepatic derangement, and are frequently associated with a gouty habit of body, and with lithic acid deposits and calculi.

Lithæmia predisposes to local inflammations. Individuals who are subject to deposits of lithic acid and lithates are more liable than others to local inflammations in a severe form. In reference to this fact, Dr. Murchison made the practical observation that in such persons the lithates cease to be eliminated on the advent of a local inflammation or ordinary febrile catarrh, to be again discharged freely on the subsidence of the pyrexia. In such cases, he added, the retention of lithates in the system has probably determined the attack.

Certain diseases of the skin, such as erythema, eczema, herpes, psoriasis, lichen, and urticaria, are unquestionably often induced and maintained by lithæmia resulting from hepatic derangement.

Other effects of this functional derangement, as Dr. Murchison remarked, 'by the production of peccant substances which are not readily eliminated, and which, therefore, accumulate in the system, may in the long run lead to many of the most troublesome, if not serious, maladies, both acute and chronic, to which our race is subject.'

(*b*) *Urea.*—This substance may be found deficient in the urine; but if so, it will be in connexion with some structural change in, as contrasted with functional disorders of, the liver, which have just been treated, and in which is found an excess of this substance. When found in such excess, we are not able always to determine whether it is due to its formation in the liver in excess. Still this excessive elimination, whatever its source, is associated with some special and important symptoms to be presently described. When the writers speak here of excess of urea, they mean such excess as is shown by the rough-and-ready method of mixing, say, a drachm of urine with a like quantity of pure nitric acid, and placing the tube containing the mixture in cold water. After some minutes or hours a few crystals may be deposited, or a mass almost solid may be formed. When there is a free discharge of urea, persons generally complain of feeling languid, often extremely so, and of inability to accomplish any work that requires mental or physical exertion. A case somewhat unique will illustrate certain points in this affection. The writer (R. Q.) was requested to see, with Mr. (now Sir William) Savory, a gentleman who complained of exceeding languor, which seemed unaccountable. He looked well nourished, and was surrounded by every comfort. His abdomen was full, and his liver somewhat enlarged. He was abstemious, living almost exclusively on a vegetable diet, owing to his great dislike to all animal food. His evacuations were pale; and inquiry showed that he was passing some sixty ounces of urine or more daily, the specific gravity of which was over 1030. On testing with nitric acid, a mass of urea occupying more than two-thirds of the mixed fluid was deposited. Blue pill and colocynth given twice or three times a week was well borne; and he also took taraxacum, with an alkali or an acid. The excess of urea in time disappeared and the patient did well. The writer has treated many like cases, but none in which the discharge of urine in connexion with urea was so copious; indeed, in many cases the quantity of urine is less than normal.[1] The sense of languor and depression in these cases is suggestive of a tonic or stimulant line of treatment. This does more harm than good. The eliminating treatment acting on the liver generally succeeds, and it may be followed by the use of some vegetable bitter tonic.

(*c*) *Albumen.*—Albumen is often found in the urine as the result of disordered liver-function. Its presence may be merely temporary, in connexion with a temporary hepatic derangement, or it may be more or less permanent. The writer watched with interest the case of a gentleman in whose urine albumen was present more or less constantly for nearly thirty years. He did much and very responsible brain-work, and lived generously. The urine had low specific gravity. Though often looked for, casts were rarely found. This gentleman himself recognised the share which the liver had in the production of the albumen, and he regularly took as he felt occasion a grain of calomel once or twice a week as a remedy.

---

[1] Dr. A. Martin (Paris, 1877) writes thus on this subject: 'It is possible to utilise in a certain degree the variations of this principle in the urine for the diagnosis of maladies of the liver.'

(*d*) *Bilirubin.*—The colouring matter of bile may be formed in excess, and found in the urine on adding nitric acid. Its presence indicates some disordered liver-function, and is so far useful in helping diagnosis.

3. **Disorders of the Biliary Function.**—Having thus described some special disorders of function as indicated by the presence of special materials found in the urine, we may now refer to disorders of the biliary function generally. These may be divided into (*a*) those due to *excessive* secretion; and (*b*) those due to *deficient* secretion. It is scarcely necessary to arrange those due to *vitiated* bile under a separate head, as the secretion may be vitiated whether it be redundant or deficient.

(*a*) *Excessive* secretion of bile is characterised by bilious diarrhœa—copious, fluid, bilious evacuations; nausea, or not infrequently vomiting; twisting, griping pains in the abdomen; and perhaps some febrile symptoms. The bile in some cases seems to be peculiarly acrid, and to cause much smarting when voided. The urine is generally high-coloured, and loaded with lithates. There is frequently headache and sleeplessness, with either irritability of temper or depression of spirits. Disturbances of circulation, in the form of irregularity of pulse, and palpitation of the heart, are also occasionally present. This excessive secretion of bile, with the attendant symptoms, is usually the result of congestion of the liver.

(*b*) *Deficient* secretion of bile is characterised by dyspeptic symptoms, such as furred tongue, unpleasant taste in the mouth, loss of appetite, and flatulence. The action of the bowels may be irregular, but is usually costive; and the evacuations are of a pale yellow, or drab, or whitish colour, and often of offensive odour. The complexion is usually sallow and anæmic, not often jaundiced. Disturbances of the circulation, in the form of languid or irregular pulse, occur, and in the nervous system, headache, languor, drowsiness, and hypochondriasis being frequent concomitants. Piles are troublesome, but afford relief when they bleed. The urine is generally dark-coloured, turbid, and loaded with lithates. There is also, in chronic cases, loss of flesh. Indeed, the action of the bile in promoting the assimilation of fat, in stimulating the peristaltic action of the intestines, and as an antiseptic, is well illustrated in the symptoms which attend protracted deficiency of the secretion.

Prognosis and Treatment.—In no class of disorders do general remedial or hygienic agents act more beneficially than in functional derangements of the liver. Pure air, exercise, strict attention to the functions of the skin, and suitable diet, are the curative means on which we must mainly rely. In all cases it is of moment to promote the healthy action of the skin and lungs. This is to be done by exercise on foot, or far preferably on horseback. The latter is peculiarly advantageous, as it stimulates directly, by a series of succussions, and by contraction of the abdominal muscles, the liver and intestines, and may be had recourse to, in moderation, by those who are not very vigorous. Walking promotes the general circulation, excites the action of the skin, increases the frequency and fulness of the respirations, and indirectly tends materially to relieve a congested or indolent state of liver. The action of the skin must also be maintained by adequate clothing in all seasons of the year, and by daily use of the bath, followed by active friction of the entire surface of the body.

The diet should be of a light nourishing character; and rich gravies, soups, made dishes, sauces, pastry, raw vegetables, and such articles should be avoided. The nitrogenous foods suit best, especially where there is associated lithæmia; starchy and saccharine articles being more or less objectionable, especially when sugar appears in the urine. The strong spirituous drinks are to be avoided; but the lighter wines, when pure, as claret, hock, and light dry sherry, may be taken at meals in moderation, or small quantities of whisky or brandy in water.

Among the medicinal remedies which promote the action of the liver and the expulsion, if not the secretion of bile, mercury and its preparations hold a prominent place. For notwithstanding the results of experiments upon animals, few practitioners will be content to give up the advantages which their clinical experience has taught them to expect from the judicious use of mercury. It has been said that the drug merely effects the expulsion of the bile; the result, however, is manifest and unquestionable. In excessive secretion of bile a single full dose of calomel, followed in a few hours by a saline draught, will cause a free downward discharge; and in the lithæmic condition of system, indicated by turbid urine containing copious lithates, the same treatment will afford ready relief. In smaller doses, repeated at intervals, and combined with other aperients, such as colocynth or rhubarb, mercury will be followed by beneficial results in less active functional derangement. In some cases mercury may be inadmissible, or may disagree; and, in any case, it is well not to repeat it too frequently, or to continue it for too long a time, as its protracted use is apt to impair digestion and nutrition, and weaken the function of the organ which it at first relieves. A valuable addition to the list of cholagogues will be found in podophyllin. A quarter of a grain to a grain of the resin may be given for a dose, combined with a little hyoscyamus or half a grain of extract of cannabis indica to prevent griping, and a grain or two of rhubarb or watery extract of aloes, or, if it is desirable to quicken the action, with some extract of colocynth, or it may be given in solution as the tincture. When the drug acts favourably it produces one or two bulky evacuations, with copious excretion of bile, followed by a feeling on the part of the patient that the bowels have been thoroughly emptied. Its action, however, is at times neither satisfactory nor certain, and it causes occasionally much griping, irritation, and tenesmus, and subsequently depression. Taraxacum is useful as a mild aperient and diuretic, and probably alterative, in functional hepatic disorders, and may be given in combination with alkalis, especially the bicarbonate of potassium or of sodium, in cases where the gouty or lithic acid diathesis exists. The dose of solid extract is from ten to fifteen grains, but the fluid extract is the best preparation, especially in combination with chloride of ammonium. Nitro-muriatic acid is indicated in cases of torpid liver associated with oxaluria (*see* Liver, Hyperæmia of). The saline aperient draught has of late been in a great degree superseded by the use of one or other of the aperient waters, the Friedrichshall, Pullna, Hunyadi, or the Rubinat, &c. These should be taken in the morning, fasting, and their effect is quickened by the addition of some warm water. The action of these waters, as of the saline purgative, is to cause a drain from the intestinal vessels, thereby relieving the congested hepatic portal system. The waters of Carlsbad, Marienbad, and other similar springs contain no sulphate of magnesium, and owe their aperient effect to the sulphate of sodium which is the preponderating ingredient. This valuable drug does not act by stimulating intestinal secretion, but, according to Buchheim, by retaining the water in which it is dissolved and that which it meets with in the bowel, and so constituting a solvent which loosens and softens and carries down solid fæcal masses and tenacious mucus. The amount of carbonate of sodium associated with the Glauber's salt in these waters renders them antacid, and assists in determining a diuretic as well as aperient action. The mineral waters, or the salts obtained from them by evaporation, may be taken at home in the morning, in conjunction with sufficient warm water. For those individuals especially who are suffering from hepatic congestion or merely functional disorder, if the result of irregular habits in eating and drinking, a visit to and course of waters at one of the spas will, if means permit, be desirable. Change of scene, regularity in diet, and absence from mental harass, are, of course, important elements in the success of a more or less protracted stay at such places; and it is remarkable how readily many individuals, who are quite unmanageable at home, submit to strict hygienic arrangements under fresh influences. Harrogate, Cheltenham, Leamington, and Scarborough in this country, Strathpeffer in Scotland, and Lisdoonvarna in Ireland, are the chief places in Great Britain. In addition to those already named, Homburg and Kissingen on the Continent are amongst the spas which enjoy special renown in the treatment of liver-affections. *See* Mineral Waters.

S. H. Ward. Richard Quain.

LIVER, Gangrene of.—*See* Liver, Abscess of; and Inflammation, Acute, of.

LIVER, Hydatid Disease of.—Synon.: Echinococci of Liver.

Anatomical Characters.—The liver is the organ most frequently affected with hydatid disease. There is usually but one cyst, but there may be two, three, or more; and the size of the cyst may vary from that of a pea to that of a child's head. The cysts may exist in either lobe of the liver, but they are more frequent in the right; and they may be attached to the upper or under surface, or project from the border, or lie buried in the substance of the gland. This is more or less modified in form, and increased in size, according to the magnitude and site of the cyst. When the cyst is small and deep-seated, there will be no appreciable change in the liver, and the disease may be latent for years. When, however, the cyst is very large, it, with the liver, constitutes a tumour, which may encroach upon the thorax, and also fill a great part of the abdomen. Pressure of the cyst may induce atrophy of a portion of the liver, but, at times, hypertrophy is the result. The bile-ducts have occasionally been found to be obliterated, or a communication to have been effected between them and the cysts. When at the surface of the organ, the cysts as they enlarge may induce inflammation and thickening of the peritoneum, and adhesion to neighbouring structures.

Symptoms.—A hydatid cyst, when sufficiently large and near the surface, generally exhibits itself as a tumour of variable size, situated either in the right hypochondrium or in the epigastric region; evenly globular in its early stages; firm, resisting, yet elastic, and, at times, with a sensation of fluctuation. Briançon and Piorry noticed a vibration or trembling—*hydatid fremitus*—which is felt when the surface is compressed gently by three fingers of the left hand, and sharp percussion made with the right hand over the middle finger. Frerichs does not consider this sign of much importance, it having been present in only one-half of his cases. If the tumour is situated behind the liver, it will, as it develops, push this organ forwards, flatten it, and increase the area of dulness. The tumour may last for a considerable time, and go on increasing to some extent, and yet the patient remain free from constitutional disturbance, perform all his functions well, and keep in good condition as regards flesh and strength. When, however, it has attained a very large size, it will give rise to various symptoms—to a feeling of tightness and distension; if it press upwards, to embarrassed breathing, cough, possibly more or less dulness, with diminished respiration, at the base of the right lung, and palpitation; if upon the abdominal viscera, to interference with their functions. Pain is not generally present, but in some cases there is a gnawing pain, either at the epigastrium or extending forwards from the lumbar region. Œdema of the lower extremities may occur when the tumour presses upon the inferior cava, or ascites from a similar effect on the portal vein. The latter is, however, not unlikely to have some associated features, tending to indicate the unusual nature of the effusion and the origin of the disease.

Diagnosis.—Hydatid tumour of the liver is not always easily diagnosed; but the characteristic features already noticed, and its compatibility (in many cases up to an advanced stage) with a good state of health, will generally point to its nature. Abscess of the liver will be distinguished by local and remote pain; the frequent antecedence or coexistence of dysentery; and severe constitutional symptoms, such as hectic fever, rigors, &c. It must, however, be remembered that hydatid cysts are liable to become inflamed and to suppurate, when the diagnosis will not be so readily made; but even so, the suppuration of a hydatid cyst is less likely to be accompanied by the acute paroxysmal fever so characteristic, if present, of abscess of the liver. Cancer of the liver will generally be marked by irregularity of surface; the presence of pain; the cachectic aspect; and the rapidity of progress. Aneurysm of the abdominal aorta may form an epigastric tumour, of even, spherical shape; but the pulsations, frequently very forcible, coupled, probably, with bruit, audible along the course of the vessel before and behind, will determine the diagnosis. The site, the pyriform shape and uniform size, and the usual accompaniment of jaundice, will distinguish from hydatid disease the tumour caused by a distended gall-bladder. Frerichs thinks that hydatid disease of the liver is more frequently confounded with localised pleuritic effusion at the base of the chest than with any other affection. He remarks that the same signs—dulness on percussion, absence of vocal thrill, intercostal fluctuation—would be present in both cases. He rests the diagnosis on the fact that the line of dulness would present a curve which would look upwards in the one case, downwards in the other. To this sign, of uncertain presence, may be added that the vocal vibration and resonance, although perhaps somewhat lessened, are not usually damped by pressure from below the diaphragm to the extent that is effected by fluid in the pleura.

Terminations and Prognosis.—Hydatid tumour of the liver may last for years, and be compatible with an average state of health; or, at an early or advanced period of its existence, it may terminate in one of the following ways: 1. It may, from its bulk and position, press upon and interfere with the functions of different organs. Pressure on the large venous trunks may induce ascites and dropsy of the lower extremities; pressure upon the stomach and intestinal canal may obstruct functions connected with the assimilation of food, and induce failure of flesh and strength, and ultimately death from exhaustion. 2. The tumour may contract adhesions with the diaphragm; ulcerative action through this may be set up, and either (*a*) discharge of the contents of the sac may take place into the pleura, and fatal pleuritis result; or (*b*) further adhesions and ulceration may effect communication with the lung, pneumonic symptoms ensue, and the contents of the sac, mixed with the products of inflammation, be expectorated. The contents are sometimes expectorated, and the disease cured by this means. 3. A rare result is adhesion to, and ulceration into the pericardium, with escape of contents, and rapidly fatal results. 4. Adhesion may be effected with some part of the alimentary canal, and the contents of the sac be discharged by vomiting or by stool. 5. Rupture of the sac may be caused by a blow or otherwise; the contents be discharged into the peritoneum; and fatal peritonitis result. 6. The tumour may contract adhesions with the parietes; point externally; and be opened or effect an opening by natural process, inflammation and suppuration having been previously set up in the sac. 7. Budd and Frerichs notice a possible cure from the obliteration of the sac by the formation within it of a putty-like matter, the combined result of degeneration of the cyst and its contents, and of inflammation outside the parent cyst. These conditions are by no means rare in the deadhouse, and they are frequently associated with calcareous changes in the cyst-wall, as well as with the deposition of brown or orange biliary pigment. So generally is pigment of this kind present in various parts of these cured hydatids, that there is good ground for supposing that the rupture of minute bile-ducts into the cyst or its wall is no uncommon thing; and, whether by killing the parasite, or by effecting slow inflammatory changes in the bed of the cyst, that it leads to a spontaneous cure in no inconsiderable number of cases. And as an illustration, although a rare one, of the extent to which the slow inflammatory changes may proceed under favouring conditions, there is a specimen in the museum of Guy's Hospital where the hydatid is surrounded by, and had no doubt determined, an enormous growth of gummatous material. 8. Communication may be effected between a hydatid cyst and one of the larger bile-ducts, and then the result will usually be fatal, although there are one or two cases recorded of recovery. 9. Similar cysts may be formed in other parts or organs of the body. 10. As a possible rare event may be mentioned communication of the sac with the ascending vena cava, escape of the contents into this, transfer of the contents to the right side of the heart, impaction in the pulmonary artery, and fatal asphyxia.

Treatment.—So long as a hydatid tumour of the liver induces no distressing symptoms, and does not affect the functions of any organs, there is no pressing cause for interference. When, however, it is rapidly increasing, is accompanied with pain or distressing distension, and especially if by upward pressure it is causing difficulty of breathing, and other symptoms, recourse should be had to tapping. If there be any doubt about the nature of the tumour, the exploratory needle may be first introduced; and should a clear fluid, free from albumen, escape, the diagnosis may be considered to be established. It is now, indeed, considered the best treatment not to wait for urgent symptoms; but when the disease is well developed, the cyst yet perhaps single, and the walls elastic, to let out the contents. This is best and most safely effected by puncturing with a fine trochar or with an aspirator. Certain precautionary measures must, however, be attended to. Prior to tapping, a broad flannel roller should be firmly applied round the abdomen, commencing from below and carrying the bandage up to the tumour, so as to assist in fixing this. It is considered desirable not to quite empty the cyst, as by doing so the chance of air entering the cyst is increased. This result may also be further prevented, and adhesion of the cyst to the parietes promoted, by applying a compress of lint over the wound and fixing it firmly with the remainder of the bandage which has been already partially applied. The patient should be kept quiet in bed for a day or two, and rest should be further ensured by the administration of morphine. The late Dr. Murchison discountenanced the use of chloroform for this operation, as the pain is but trifling, and the chloroform may induce vomiting, which would interfere with the subsequent rest of parts, so desirable to ensure a successful result. It is not necessary to wait for the adhesion of the cyst to the parietes before puncturing, as the use of a fine trochar diminishes the risk of escape of the contents of the sac into the peritoneum; and, moreover, the escape of a certain amount of fluid will not usually induce peritonitis. A large proportion of cases thus treated have been successful.

When a hydatid cyst has suppurated, it should be opened by free incision, and the contents allowed to evacuate themselves. The cyst may be opened immediately or by two stages, according as it is adherent to the parietes or not. Free drainage must be ensured in accordance with the principles of modern antiseptic surgery.

Puncture and subsequent injection of the cyst with some stimulating fluid; gradual opening of the cyst by applications of caustic potash, so as to ensure adhesion with the parietes; and a large incision with a view to effective removal of contents, are methods of treatment which have been practised, but cannot be recommended in comparison with simple puncture with a fine trochar; but, as regards incision and evacuation, the success of modern surgery is such that it may now be resorted to with less misgiving, and is even strongly advocated by some. There would, however, appear to be some risk of hæmorrhage from the bed of the cyst after incision; and inasmuch as there may be several cysts, and simple aspiration is free from any serious danger, and is often successful in inducing quiescence, at any rate, in the cyst for long periods of time, the simpler measure should, unless specially contra-indicated, be first adopted.

The late Dr. Hilton Fagge and Mr. Durham treated several cases successfully by acupuncture, and by passing a galvanic current through the contents of the cyst; but it seems not improbable that the result may have been due to the acupuncture, and not to the galvanic influence. Treatment by special medicinal agents, administered internally, has been fairly tried. Of these, common salt and iodide of potassium in large doses may be mentioned. They have, however, proved entirely useless.

Stephen H. Ward. James F. Goodhart.

LIVER, Hyperæmia of.—Synon.: Congestion of the Liver.

Definition.—Uniform enlargement of the liver, with preservation of its normal shape; caused by over-distension with blood, the result of mechanical obstruction to the return of blood to the heart, or of direct afflux of blood through the portal vessels; attended with a sense of fulness and oppression in the right hypochondriac and epigastric regions, and a dusky and sometimes jaundiced complexion.

Ætiology.—Congestion of the liver may be either *active* or *passive*. Niemeyer limits the term 'congestion' to the latter, and applies the term 'fluxion' to the former. *Active hyperæmia* or congestion results from—1. Excess in eating and drinking, especially in persons of sedentary and indolent habits. Determination of blood to the liver occurs, to some extent, in the process of digestion in connexion with ordinary meals, and if these consist of rich and irritating materials, and are repeated too often, or if the liver is stimulated between meals by the imbibition of spirituous liquors, the hyperæmia may become excessive and continuous. 2. Long exposure to a tropical or sub-tropical temperature will perhaps induce hepatic congestion, but such influence may be long resisted by persons of temperate habits; and it is probable that the association of irregularities in eating and drinking mainly contributes to the result. 3. A chill, after exposure to heat, may induce active hepatic congestion, which, in hot climates, may result in suppurative hepatitis. 4. It may be excited by injuries to the liver—such as contusions or wounds. 5. Hyperæmia of the liver, with enlargement, occurs in connexion with typhus fever and other acute exanthemata, puerperal fever and scurvy. It is also a result of prolonged exposure to malaria, with or without attacks of pronounced ague. This influence is the main cause of the enlarged livers with which 'old Indians' return to this country.

Passive hyperæmia, to which the term *mechanical congestion* is applied by some authors, is due to interference with the return of blood from the liver through the hepatic vein and inferior cava to the heart. Such interference may be due immediately to dilatation of the right heart, with affection of the tricuspid valve; to obstruction to the circulation in the course of the pulmonary artery, caused by different diseases of the lungs; or, farther on, in the line of the circulation, to disease of the mitral or aortic valves. The affections of the lungs which interfere with the pulmonary circulation are either acute, as pneumonia, and then the hepatic hyperæmia may pass off with the disease; or they are chronic, as emphysema and fibroid disease, and then the hyperæmia will persist. Mechanical congestion of the liver may result from direct obstruction to the flow of blood by the pressure on the vena cava of aneurysmal or other tumours. Mere weakness of the heart's action often keeps up a certain amount of passive congestion.

Anatomical Characters.—A hyperæmic liver is increased in size about equally in all directions; its resistance is also increased; its peritoneal investment appears distended and shining. On making an incision blood oozes out freely, and the cut surface is dark red—either uniformly so, or spotted with intervening lighter spaces. In the passive or mechanical form, the central vessels of the lobules—the hepatic veins—are engorged; and when persistently so, as in disease of the mitral valve, the cut surface gives the characteristic appearance to which the term *nutmeg liver* has been applied. The dark centres contrast with the pale circumference of the lobules, the light and dark parts being clearly defined, but varying according to the section; the surface gives an appearance which resembles closely that of a cut nutmeg. The central dark spots result from distension of the hepatic veins, and deposition of bile-pigment in the adjacent hepatic cells, which are more or less atrophied by pressure; the lighter spaces correspond to the interlobular veins, the light colour being due, according to most pathologists, to the presence of fat in the cells at the circumference. Dr. Wickham Legg, however, states, as the result of an examination of twenty cases of nutmeg liver, that the fat was not in excess in the majority of them. In addition to the atrophy of the cells by pressure of dilated hepatic veins, there may be hypertrophy of the interlobular hepatic tissue, with lymphoid bodies scattered through it. The term 'red atrophy' has been applied to this advanced stage of nutmeg liver, but, as Dr. Legg remarks, it is objectionable, as having been previously used by Virchow to designate a state of liver met with in wasting diseases, such as typhoid fever. The term 'atrophic nutmeg liver' answers well.

Symptoms and Sequelæ.—In slight cases of hyperæmia the liver does not extend much beyond its normal limits, but it may perhaps be felt below the borders of the ribs and across the epigastrium. In severe cases, and especially in passive hyperæmia from obstructed circulation, the organ often attains a considerable size, and is found, on percussion, to extend upwards into the mammary region, downwards nearly to the umbilicus, and across into the left hypochondrium. Its resistance is generally increased, and, in old-standing cases, such as the local condition often seen in the deadhouse as the effect of tight-lacing, it may even be hard enough to create the suspicion of malignant disease. There is often, especially in acute cases, tenderness on pressure. The patients do not exactly speak of pain, but of a sense of oppression and fulness in the right hypochondriac and epigastric regions, and of uneasiness from the pressure of clothes, or on lying on the left side. In most acute cases there is marked functional and general disturbance; a furred tongue, nausea, vomiting at times of bile, bilious diarrhœa, sallowness of complexion, or some amount of jaundice. In certain cases the bile seems to be peculiarly acrid, and causes much griping and distress as it passes downwards, and smarting as it is voided. The urine is high-coloured, and loaded with lithates. The patients often complain of headache, are irritable and depressed in spirits, and feel languid and drowsy. Disturbances of circulation are indicated, in severe attacks, by irregularity of the pulse and palpitation of the heart. When jaundice is present in any marked degree, there is probably catarrh of the bile-ducts, and transient obstruction of these ducts, and then the evacuations are devoid of bile.

The hyperæmic condition of liver induced in India or other tropical regions, as the result of high temperature and malarious influence, may terminate in chronic enlargement, and possibly in damaged structure of the organ. The symptoms which mark this are cachexia and anæmia, with sallowness of complexion; a weak circulation, indicated by great susceptibility to changes of temperature, and by chilliness or coldness of the lower extremities; disturbances of the nervous system, shown by irritability, depression of spirits, disinclination from effort of any kind, headache, and giddiness; and other complaints. Dyspeptic symptoms are present. The bowels are either constipated or relaxed, the stools in either case showing a deficient or vitiated secretion of bile. The urine sometimes contains bile, frequently oxalate of lime, and excess of urea. The skin is dry and harsh.

In the mechanical form of hyperæmia there are, in addition to special gastric and hepatic symptoms, other symptoms indicative of the pulmonary or cardiac affection on which it depends. The complexion is more or less dusky, and there is a certain amount of lividity mixed with the jaundiced hue. The liver may be found to vary in size in accordance with the variations in the conditions which give rise to it. It may sometimes pulsate. Ascites may now become a prominent symptom, whilst, as Niemeyer remarks, the general dropsy resulting from associated heart-affection may be yielding to treatment.

Diagnosis.—Hyperæmia of the liver, when it is the result of obstruction to the circulation caused by diseases in the chest, is easily recognised. Also, when of the active kind and acute, it is not likely to be mistaken for any other cause of enlargement. It is only when the congestion is chronic, and the liver hard and resistant, that an erroneous diagnosis may be made; but the previous history of the case, and associated general symptoms, will lead to a right conclusion. It might be mistaken for albuminoid disease, but then the liver may be really undergoing this degeneration.

Prognosis.—Active hyperæmia of the liver usually ends favourably on removal of the exciting cause, and under appropriate treatment. The following considerations will, however, influence the prognosis: 1. An attack of hyperæmia in an individual of intemperate habits may be but the early stage of cirrhosis. 2. A similar attack, occurring in India, may, as Dr. Maclean remarks, be but the commencement of acute hepatitis, which may end in suppuration. 3. The prognosis in the mechanical form of congestion, dependent upon disease in the chest, will be influenced by the nature and stage of such disease.

Treatment.—An attack of acute hyperæmia of the liver will usually be relieved quickly by rest; by restriction to a bland, fluid diet; and by ensuring free action of the bowels by a dose of calomel, followed after a few hours by a saline aperient, either in the form of a draught, or of one of the more active mineral waters. A single sufficient dose of calomel, four or five grains, will often rapidly relieve attendant gastric irritation and vomiting, and ensure a free downward discharge of bile. Should there be much tenderness on pressure over the liver, the application of sinapisms or turpentine stupes, followed by hot poultices, will be beneficial. So long as any acute symptoms continue, the patient should be kept quiet in bed; the diet should be light and fluid; and stimulants should be rigorously excluded. The portal system must be kept relieved by a dose of Pullna or Friedrichshall water, or by a saline draught, every or every other morning, preceded the previous night by some mercurial preparation, if the secretion seem to require this. Podophyllin may be advantageously substituted for mercury in some cases, but it is uncertain in its action. Its griping effect is counteracted by the addition of a little extract of hyoscyamus or half a grain of extract of cannabis indica, and its action will be quickened by adding a little compound colocynth pill. When the acute stage of hyperæmia is passed, taraxacum often acts well as a purgative and alterative; combined, in subjects of gouty habit, whose urine is more or less charged with lithates, with bicarbonate of potassium, or, in other cases, with diluted nitro-hydrochloric acid. This acid, in torpidity and chronic enlargement of the liver, is one of our most effective remedies. It acts by altering and promoting the biliary secretion, and by improving the tone of the digestive organs. In the chronic enlargement of liver of 'old Indians,' in that which results from malarious poison, and also in other forms of chronic congestion, it often acts very beneficially. It may be used both internally and externally. Ten to twenty drops of the diluted acid of the Pharmacopœia may be given two or three times daily, combined with taraxacum, quinine, or other drug, according to indications. The external use of the acid has been advantageously had recourse to at the Seamen's Hospital for years, either in the form of compress over the abdomen, or by sponging the surface of the body, or by the use of baths to the lower extremities. The fluid for the bath or compress is prepared by adding eight ounces of the diluted acid of the Pharmacopœia to a gallon of water at about 98° F. The compress may be applied by soaking a flannel roller of sufficient length, about a foot in width, in the prepared acid, and wringing it so that it merely remains damp. The roller should be then applied round the body, covered with a piece of oiled silk, and worn constantly—subject, however, to renewal of acid night and morning; or the lower extremities may be immersed in the fluid for about twenty minutes, night and morning, and the inner sides of the thighs and the body be sponged at the same time. Earthenware or wooden baths should be used; and the sponges and towels after each bath must be well washed in cold water, or they will be destroyed by the acid. At times the external use of the acid causes purging; and in several cases, at the Seamen's Hospital, severe irritation of the skin, with copious papular eruption, resulted, and the remedy had to be discontinued. Chloride of ammonium and iodide of potassium must be mentioned as drugs that have been found serviceable in reducing livers enlarged by chronic congestion.

In the hyperæmia resulting from disease of the mitral or aortic valves, or from chronic pulmonary changes, it is sufficient to remark that the chest-symptoms will often be most effectually relieved by treatment directed especially to the liver.

Much benefit will result in many cases of hyperæmia from a course of mineral waters at one of the German or English spas. Marienbad, the cool springs of Carlsbad (rather than the Sprudel), Kissingen, Cheltenham, Harrogate, &c., are indicated in active hyperæmia; the more tonic waters in the more chronic forms of congestion. A more detailed notice of the different spas and waters in relation to hepatic affections will be found under other articles. *See* LIVER, Functional Disorders of; and MINERAL WATERS.

STEPHEN H. WARD. JAMES F. GOODHART.

LIVER, Hypertrophy of.—In true hypertrophy of the liver, the increase in the size of the organ is due to enlargement and multiplication of the secreting cells, without any morbid change having taken place in these, and without the deposit around them of any morbid material. The parenchyma of an hypertrophied liver is generally firm and vascular, in some few instances pale and flabby. The hypertrophy may be *partial* or *general*. *Partial* hypertrophy may either result from localised irritation of the liver, as in tight-lacing; or it may compensate for some other portion of the organ reduced or entirely destroyed by disease, as in the large irregular lobules of hepatic tissue formed in advanced cases of syphilitic hepatitis. *General* hypertrophy has been found in some cases of diabetes mellitus; in leukæmia; and, according to Dr. Jules Simon, in a certain cachectic condition produced under the combined influences of deprivation, scrofula, and residence in a damp locality. Whether true hepatic hypertrophy can be caused by residence in hot climates, or by prolonged exposure to malaria, seems, according to Frerichs, to be open to doubt. It is probably due in some instances to prolonged congestion of the liver, and, as a result of such a condition, may occasionally be met with in drinkers and free livers, and in the subjects of pulmonary and cardiac diseases.

W. JOHNSON SMITH.

LIVER, Induration of.—The liver is commonly hardened whenever it is small. Simple induration is a state in which new connective tissue seems to replace the proper hepatic tissue throughout large tracts of the liver. Often the organ becomes small and lobulated; at other times it is increased in size, and a case has been known in which it weighed eight pounds, constituting a connective-tissue hypertrophy of the liver. The diseased part presents the appearance of a completely homogeneous, whitish-yellow, firm, hard mass; which under the microscope is seen to be made up of connective tissue, in which no, or very few, elements of liver-substance can be made out.

J. WICKHAM LEGG. STEPHEN MACKENZIE.

LIVER, Inflammation of, Acute.—SYNON.: Acute Hepatitis; Fr. *Hépatite Aiguë*; Ger. *Acute Leberentzündung.*

It is usual to divide acute inflammation of the liver into *perihepatitis*, involving the investing membrane of the liver and Glisson's capsule; and *hepatitis*, in which the parenchyma of the liver is engaged—in other words, into superficial and deep-seated; but, practically speaking, perihepatitis is rarely more than an accompaniment of hepatitis, of peritonitis, or of an acute attack of a neighbouring organ. We shall not treat of the two separately, as they are constantly associated with each other.

ÆTIOLOGY.—Acute hepatitis is by no means a common affection in Europe, and even in the tropics congestion is far more frequent than acute inflammation. The chief causes of hepatitis are exposure to heat and to changes of temperature—both of which have a large share in what is called tropical influence—irregular habits of life, and spirit-drinking. Irregular action of the liver and of the bowels predisposes to it. Men in the tropics are far more subject to the disease than women or children—in fact, acute hepatitis is exceedingly rare in children. The disease is uncommon in men under the age of twenty, and appears to be most frequent between the ages of twenty-five and thirty-five. Independently of the cases in which it appears to be connected with dysentery, many authors believe hepatitis to be induced by the same causes as those which produce tropical dysentery, and tropical fevers—in other words, by malarious influences. Hepatitis or perihepatitis is sometimes occasioned by falls, or by external violence, which may operate in producing them either directly or secondarily.

Anatomical Characters.—The liver when inflamed is usually represented as softened and congested, sometimes having a granular appearance. When cut into, more blood flows from it than usual. It is sometimes infiltrated with serous fluid, with lymph, or occasionally with small spots of pus. While portions of the liver are involved in inflammation, other portions may be unaltered; but most generally it is inflamed or congested throughout, in some parts in red patches, while in other parts there are patches of a yellowish colour. These may be traced in their changes until they are converted into abscesses, which may be single, or less frequently multiple; usually these are enclosed in a cyst, which varies from the thinnest half-formed membrane to a tolerably tough one. If there has been much perihepatitis, the liver is very commonly adherent to the diaphragm or to the neighbouring viscera by organised lymph, and its capsule is thickened.

With reference to the distribution of its blood-vessels, it has been presumed that congestion of the liver is mainly caused by obstruction to the hepatic veins, consequent on affections of the heart or lungs, or by some obstruction of the vena portæ, or morbid alteration of the blood which it conveys. In inflammation, again, the capillaries of the hepatic artery are believed to be primarily engorged. But these matters are not very certain. As respects suppurative inflammation, Budd maintained, and rightly as regards many cases, that it is the result of purulent matter taken up from ulcerating surfaces of the bowel, and conveyed to the liver by the vena portæ.

Symptoms.—These vary much in their degree of acuteness. There is frequently in the commencement chilliness, or even some shivering, followed by fever. The appetite is impaired, and there may be loathing of food. The tongue is white, and usually has a thick white coat. The bowels are sometimes constipated; more frequently there is diarrhœa. Sometimes there is great thirst, along with irritability of the stomach and bilious vomiting. A certain degree of jaundice has been often set down as a symptom of hepatitis, but it is very unusual. There is frequently pain in the right shoulder, but by no means always. There is often a short, dry cough. There is generally some fever; the pulse is usually from 100 to 110, and the temperature of the body is increased two or three degrees; but there is seldom present that amount of irritation which one would expect to find when inflammation is so acute that it may end in suppuration. In the region of the liver the symptoms are various. Sometimes there is sharp lancinating pain, especially when the convex surface is most affected; more frequently there is a dull, heavy pain, which is increased when the patient endeavours to lie on his left side. There is generally pain in the liver on pressure. On careful examination the viscus will often be found to be increased in bulk, but by no means always so. It may be enlarged upwards and backwards, or below the edge of the ribs, or towards the epigastrium. If the inflammation be at all acute, or if there be perihepatitis, which may involve the lower surface of the diaphragm, there may be shortness of breathing, which is often very distressing. The acuteness of suffering depends very much on whether the surface or the deeper portion of the organ is most involved in the inflammation. The urine is commonly high-coloured, and contains an excess of bile-pigment. Sometimes albumen is present, but on the whole nothing very definite is known on this point.

As regards the duration of the symptoms, if there only be perihepatitis, they will probably subside in three or four days. Deep-seated hepatitis may end in about ten days in resolution, or in the formation of abscess (*see* Liver, Abscess of); or the disease may be protracted in a less acute form for weeks or months, producing enlargement or partial induration of the liver. In such cases, and indeed in the less acute form of hepatitis, it is often difficult to draw a distinction between chronic congestion and chronic inflammation.

Diagnosis.—Hepatitis is not very likely to be confounded with other affections. If the surface is particularly involved, when there is much shortness of breath, and the pains are lancinating, it may be confounded with local pleurisy or pneumonia. The auscultatory sounds, as also the position of the patient, will show whether the lungs are affected—for with pneumonia, with intercostal neuralgia, with inflammation of the stomach, or with the passage of gall-stones, he will not lie on the affected side, as in hepatitis; nor is there in these diseases the excessive irritability of stomach that there is in inflammation of the liver. The pain of gall-stones comes on more suddenly, is more acute, and disappears more rapidly. Sometimes hepatitis has been confounded with enlargement of the gall-bladder, but usually the pyriform shape and prominence of that organ when over-filled should be enough to distinguish it. As for the diagnosis between hepatitis and perihepatitis, it is chiefly of importance as regards the prognosis. The pain in the latter is usually more acute, less of a dull pain, and is less persistent. The parenchyma of the viscus is less sensitive than its surface, as has appeared to the writer, on handling and cutting off two or three inches of liver which had protruded through a wound.

Prognosis.—The prognosis of hepatitis is grave, but its termination is generally favourable in temperate climates, especially when the case is one rather of perihepatitis than of hepatitis. In the tropics the disease is much more formidable. There is always the risk of its running into abscess; or, if that be avoided, of a state of chronic hyperæmia of the organ, with enlargement and constant tendency to relapse supervening. The complication with dysentery or chronic diarrhœa is frequent and unfavourable. The ratio of mortality differs much in different places, and in the same place in different seasons; and it is difficult to ascertain the absolute mortality of hepatitis, as long as congestion and inflammation of the liver are not distinguished in statistical returns. However, hepatitis (if cholera be excluded) has long been, and continues to be steadily, the greatest source of mortality among our soldiers in India. The French found it a very fatal disease in Algiers, and it has always been one of the most serious diseases of hot countries.

Treatment.—The activity of treatment must be regulated by the acuteness of the case, and by the presence or absence of complications, such as dysentery. In former days repeated venesection used to be employed. We now find a few leeches applied over the liver or to the anus at least as effectual. Emollient cataplasms are to be kept constantly applied to the side. The bowels should be freely acted on with the neutral salts. The action of ipecacuanha in large doses is very useful, whether it produces nausea or operates on the bowels. It is particularly indicated where there is dysenteric complication. The general feeling is that the induction of vomiting operates unfavourably, but in the early stage of the disease a certain amount of this action is not injurious. It seems to relieve the liver to some extent. Calomel and opium, and the exhibition of calomel in small doses, to touch the gums, was the old treatment in India; while the French trusted mainly to the exhibition of calomel, ipecacuanha, and opium. Both modes of treatment were believed to yield satisfactory results. The popular idea that if the patient was once salivated he was secure from the formation of abscess has no foundation in fact. If there is much general fever, the use of an ordinary diaphoretic mixture, with a larger proportion of tartar emetic, will be found useful; if nausea is produced, so much the better. When the symptoms become less acute, the steady use of moderate saline aperients, or of iodide of potassium—in short, the ordinary treatment for congested liver, should be adopted. Counter-irritants and blistering, or the application of tincture of iodine over the liver, are of more use in this than in the earlier stages. The nitro-muriatic acid bath has long been a popular remedy in the chronic stage of hepatitis. The body may be immersed, but a bath for the feet, or sponging the side with a solution of the acid, will usually be found as efficacious. The internal use of the mineral acids the writer believes to be more effective. Change of climate exercises a singularly beneficial effect; especially that obtained by a sea-voyage. Sudden exposure to cold, however, after a return from a warm climate, must be particularly guarded against. The treatment of the sequelæ of hepatitis becomes practically that of congestion of the liver. The steady use of saline aperients, or a resort to the saline-alkaline, or to alkaline baths, as Carlsbad, Marienbad, Elster, Vichy, and others, will be found beneficial. In the acute stage the diet must be low, and limited chiefly to fluids. Great attention must be paid to diet during convalescence also. This will help materially in preventing the disease from becoming chronic; and, indeed, there is no better prophylactic against hepatitis than a carefully regulated diet, with abstinence from spirituous drinks.

J. Macpherson.

LIVER, Inflammation of, Chronic. This is usually only another name for cirrhosis. Sometimes the name is given to a perihepatitis, a thickening and opacity of the capsule enclosing the liver, and beneath which the liver-substance is found hardened and tough, due to an over-growth of the connective tissue from the capsule. Most pathologists, however, look upon cirrhosis as a chronic inflammation of the liver, and the name is usually restricted to this state. A chronic inflammation of the liver is also induced by syphilis, both congenital and acquired. *See* Liver, Cirrhosis of.

J. Wickham Legg. Stephen Mackenzie.

LIVER, Malformations of.—Abnormalities in the form of the liver are not common, and are more often acquired than congenital. The following are some of the most frequently observed malformations that are *congenital*, and due to some original defect: A more or less quadrangular liver; a rounded liver; reduced proportions or total absence of left lobe; prolongation of the left lobe in the form of a narrow tongue-like process towards the region of the spleen; abnormal grooving of the surfaces of the liver; extreme depth of normal fissures. Another occasional variety of hepatic malformation consists in extensive lobulation, and the existence of one or more additional small lobes—a condition met with in the livers of rodent animals. An extreme instance of this extensive lobulation was observed by Dr. Dickinson, and is recorded in the *Transactions of the Pathological Society* (vol. xvii. p. 160). Acquired malformation may be due to hepatic abscess; to hydatid disease; to new-growths; to some form of chronic inflammation (cirrhosis, syphilitic disease); or, finally, to compression of the organ by tight-lacing and other means. In cases of hepatic malformation caused by tight-lacing, the upper part of the right lobe may be traversed from side to side, either by a single very deep furrow, or by two or more shallow depressions with elevated transverse folds of liver-tissue between them. In those instances in which the constriction has been so applied as to 'fold up' the liver, and to increase its convexity from before backwards, a single deep transverse furrow is often formed on the under surface of the right lobe.

According to Wilks and Moxon, compression of the waist by a strap often causes a transverse groove or depression, with a fibrous appearance, running just above the anterior edge of the liver in front.

Dr. Coats has described a furrowed condition of the upper surface of the liver, in which elevated folds of hepatic structure, with corresponding depressions, take a direction from before backwards. This furrowing occurs in cases of obstructed respiration, and is held to be due to the pressure of the lower ribs on the liver, which organ is more or less fixed by depression of the diaphragm and by the strongly contracted abdominal muscles.

W. JOHNSON SMITH.

LIVER, Malignant Disease of.—DEFINITION.—Development in the liver of cancerous or sarcomatous growths, either primary, or secondary to similar growths elsewhere; causing, generally, enlargement of the organ, with irregularity of its surface; attended with pain, often with jaundice and ascites, with marked cachexia and progressive emaciation; and having usually a rapidly fatal termination.

ÆTIOLOGY.—Hepatic cancer is so largely a disease transported to the liver from other organs by the various vessels that supply it with blood and lymph, that its *raison d'être* is that of the various primary growths from which it emanates—in the stomach, the intestine, the sexual organs, the breast, the eye, &c. Thus it is rare in early life. Of eighty-three cases analysed by Frerichs, forty-one were between forty and sixty years of age, and the remainder in nearly equal proportions above and below that period. Climate, habits of life, over-indulgence in the use of spirituous liquors, do not seem to play any part in determining the malady. The influence of hereditary tendency to cancer must not, however, be overlooked. Malignant disease of the liver is primary in about one-fourth of all cases; secondary in the remainder; and, in about one-half of the cases in which it is so, the primary disease has been seated in structures connected with the portal system. Of such as *originate* in the liver, the disease in the larger number commences in the gall-bladder or the bile-ducts, and is of the nature of cylinder-celled cancer. Some few, at any rate, have appeared to be the direct outcome of the local irritation of a gall-stone.

ANATOMICAL CHARACTERS.—Malignant disease of the liver may be either carcinoma or sarcoma, the former being either hard or soft (scirrhus or medullary), the latter round-celled and occasionally melanotic. Colloid cancer is rare, and spreads from the stomach or peritoneum. Cancer may occur as an infiltration of the liver-tissue, when large masses of the liver are uniformly affected, and little or no irregularity of surface results. It usually, however, occurs in circumscribed masses, smaller nodules or larger protuberances, varying in size, to use a familiar comparison, from that of a pea to that of a child's head. These masses are more or less numerous, and usually distinct; or they may encroach upon one another, and coalesce. When near the surface, they give rise to the marked irregularity which is very characteristic of the disease; and, when large and numerous, cause considerable increase in the size of the liver. The masses on the surface are sometimes flattened, and have a central depression which has been designated as 'cancer navel.' The cut surface is either white, or reddish-white, or darker red when blood has been recently extravasated, or of varying colour, from altered blood-pigment, when the extravasation of blood has been of longer date. The portal and hepatic veins are sometimes invaded by the cancer.

SYMPTOMS.—In the earlier stage of this disease, the symptoms may be merely subjective, and then diagnosis will be difficult. When far advanced, however, a prominent irregular swelling may be seen, raising the abdominal parietes, and occupying often a large portion of the abdominal cavity. Lesser grades of the disease may be detected by palpation and percussion. The liver will be found to extend more or less beyond its normal limits; to be hard and resisting; and, in a large proportion of cases, irregular. In a few cases, however, when the disease is of an infiltrating form, the surface will perhaps be smooth throughout. At times there is no enlargement of the organ, and the portion affected lies under the ribs, so that physical examination does not help us. There is often tenderness on pressure, especially when the peritoneal coat is inflamed. Usually, but not always, there is pain in the liver itself; sometimes merely a feeling of tightness and fulness; at other times a gnawing, aching pain; and some patients have described the pain as 'burning.' There is frequently also pain shooting back to the spine, over the sacrum, or about the angle of the right scapula. A sensation as of a cord drawn round the right hypochondrium has been complained of. There is sometimes pain radiating down to the lower part of the abdomen; and occasionally wandering pains in the extremities and body generally are complained of. When the stomach is intact, there may be no material disturbance of its functions, but usually derangement is manifested by loss of appetite, nausea, vomiting, and other symptoms, which will be intensified if the stomach is implicated in the disease. The bowels are, as a rule, constipated in the earlier stage, but towards the close there is often dysenteric diarrhœa. Jaundice occurs in nearly one-half of the cases of malignant disease of the liver, and is due to compression of the bile-ducts by cancerous masses within the organ, or by an enlarged lymphatic gland in the portal fissure. When once established it is permanent, and the colour of the patient varies, being pale yellow, or deep olive-yellow, or greenish, or sometimes of the dark hue which has given rise to the term 'black jaundice.' The stools in such cases are white or clayey in appearance; and the urine deep-coloured from bile-pigment. The condition of the urine, when there is no jaundice, is variable; in the earlier stages of the disease it is generally scanty and pigmented, and loaded with lithates; in the last stage, according to Dr. Parkes, copious, pale, and deficient in urea. This condition he attributes to the utter failure of digestive and nutritive power. Ascites is present in more than half of the cases, and is due either to compression of the portal vessels, or to implication of the peritoneum. Sometimes the large size of the tumour, especially if ascites to any extent be present, may cause much pressure upwards, and give rise to distressing chest-symptoms, such as embarrassed breathing or palpitation. Hæmorrhage not infrequently occurs in advanced cases. The blood may come from the stomach or bowels, and be due to portal obstruction; or may be of passive character, as in scurvy or purpura; and the bleeding may take place beneath the skin, or come from the stomach or bowels. In the latter case the hæmorrhage is accompanied, according to Frerichs' experience, by intense jaundice, and usually by somnolence and delirium. The complexion of patients suffering from the disease under consideration, when there is no jaundice, is usually sallow, anæmic, earth-coloured. There is, in a large majority of cases, progressive and, towards the close, often extreme emaciation. Generally there is no fever, but a sort of hectic may occur when the cancerous development goes on rapidly, and involves several organs. When the disease of the liver is secondary to, and complicated with cancerous affections of other organs, as the stomach—which occurs in a considerable proportion of cases—pancreas, uterus, or mammary gland, symptoms will exist indicating such complications, but need not be specially dealt with here.

Diagnosis.—When hepatic cancer is somewhat advanced, and the liver large and irregular on its surface, the diagnosis will be easily effected. In the early stage, on the contrary, and throughout some cases in which the liver is not perceptibly enlarged, one must be cautious in giving a hasty or too decided opinion. Inherited tendency to cancer; the age of the patient; in women the period of 'change of life'; a sallow, earthy aspect; progressive emaciation; and pain in the right hypochondrium, point with fair probability to the disease. But nearly the same conditions and symptoms may be associated with aggravated hypochondriasis, or chronic tendency to gall-stones; and in the latter case the difficulty of diagnosis is increased, as gall-stones are often associated with cancer. Permanent closure of the bile-duct from other causes gives rise to persistent jaundice and other symptoms, as in the case of closure by pressure from a cancerous mass. Enlargement of the liver from malignant disease may be confounded with the following hepatic enlargements and malignant tumours: 1. Albuminoid or lardaceous disease. In this affection the hard, perfectly smooth surface, with preservation of normal shape of the liver, and absence of pain in the tumour and of jaundice, will be sufficiently distinctive, accompanied as it should be by associated indications in other organs. 2. In many cases of cirrhosis, as also of malignant disease, the liver is enlarged and its surface uneven, and in both diseases there is great resemblance in the aspect and general cachectic state of the patient, and similar disturbance of gastric and hepatic function. In cancer, however, the ascites is generally but slight, and the liver, instead of contracting, as it usually does in cirrhosis as the disease progresses, continues to increase, and is marked by large hard nodules and protuberances, which contrast with the more general but less stony enlargement in cirrhosis. In cancer the skin is often moist; in cirrhosis it is harsh and dry. Intemperance is not an element in the ætiology of cancer, as it is in cirrhosis. In the latter disease, as also in lardaceous liver, the spleen is frequently enlarged. 3. Hydatid tumour is to be distinguished from a localised cancerous mass by the presence of more or less distinct fluctuation; and the absence of pain, and of serious functional and constitutional symptoms. 4. A tumour caused by hepatic abscess would probably give evidence of fluctuation; be associated with or consecutive to dysentery; and often attended by rigors, hectic fever, and characteristic shoulder-tip pain. 5. Malformations and malpositions of the liver have been mistaken for cancerous enlargement, especially in females about the period of 'change of life.' 6. A largely distended gall-bladder has been mistaken for a cancerous projection from the liver; but the smooth oval swelling, and the site of the enlargement, are distinctive, and, as Frerichs says, a practitioner who made an erroneous diagnosis in such case would be wanting in the *tactus eruditus.* 7. Cancer of the omentum would present a movable tumour, separable, probably, from the liver by a slight area of tympanitic resonance. 8. Cancerous deposits in the left lobe of the liver may be readily mistaken for cancerous affections of the stomach. The following points will assist in diagnosis: (*a*) Percussion in the greatest thickening of the walls of the stomach gives a tolerably clear, tympanitic sound; in cancer of the left lobe of the liver, the sound is much more deadened, and is only somewhat tympanitic on stronger percussion-stroke; (*b*) careful examination of the liver, and of the stomach, when full and when empty, will also lead to a correct conclusion; (*c*) even when the liver and stomach are both affected, careful examination may often make out the boundaries of disease in each. 9. Malignant tumour of the right lobe may be mistaken for enlargement of the right kidney. Percussion will generally give a tympanitic sound, from the presence of intestine between the kidney and liver. The hepatic tumour is also distinguished from this and other abdominal tumours by its following the movements of the diaphragm in respiration. But when the renal enlargement is very great, diagnosis is not easy. 10. Malignant disease of the ascending or transverse colon will constitute a movable, and generally somewhat tympanitic swelling; and fæcal accumulations in the colon may be removed, but not always readily, by aperients and injections. Percussion, too, will often elicit a resonant space between the enlarged intestine and the liver.

Prognosis.—The prognosis is always unfavourable. The disease, when once fully pronounced, runs its course rapidly, the fatal termination being seldom deferred beyond a year. Scirrhus has usually a longer duration than medullary cancer.

Treatment.—This can be but palliative, and directed to rendering the inevitably fatal course as smooth as possible, by relieving distressing symptoms. Remedies which in other hepatic affections are valuable, such as cholagogues, or mineral waters, are here useless, if not worse. The diet should be plain and nourishing; and the moderate use of wine and alcohol is not contra-indicated, as in other disorders of the liver. Serious gastric and other derangements must be met by appropriate remedies; it being always borne in mind that we have to soothe the patient, and not add to his distress by the exhibition of nauseous drugs. For the relief of pain, the various preparations of opium are indicated, and, as a rule, morphine acts the best. It may be administered either internally, or by the hypodermic method, and must be repeated when pain demands it. Local applications over the liver, as poultices, spongiopiline, &c., with solution of opium sprinkled over the surface, are useful, especially when the peritoneal coat is inflamed. Tapping should not be had recourse to for the relief of ascites, unless this becomes so great as to interfere by upward pressure with the functions of the lungs or heart. The fluid soon re-accumulates, and the effect of the operation is to hasten the fatal termination.

Stephen H. Ward. James F. Goodhart.

LIVER, Malpositions of.—Abnormalities in the position of the liver are much less rare than abnormalities in its form. The more frequent forms of *congenital* displacement include—Lateral transposition, the liver being found on the left instead of the right side of the abdomen; eventration, the organ being exposed in front of the abdomen of a fœtus; the presence of more or less of the liver in the chest, through congenital deficiency of the diaphragm. In *acquired* displacement the liver may be either depressed or elevated, some rotation of the organ on its transverse axis taking place in an opposite direction in each case. Depression may be caused by pressure from above, as by effusion in the right pleural cavity, and probably to some slight extent by considerable pericardial effusion, or cardiac hypertrophy. Elevation of the liver, which takes place more frequently, may be due to pregnancy, ascites, or the presence of some large abdominal tumour. Curvature of the spine, whether lateral or angular, usually gives rise to some change in the position of the liver. In Pott's disease the organ is often forced downwards towards the crest of the right ilium.

By tight-lacing both the position and the form of the liver may be altered. The organ may be forced downwards, and at the same time so twisted on its transverse axis that its convex surface looks directly forwards, and its concave surface directly backwards. When tightly compressed, the upper surface of the right lobe becomes marked by the ribs, and presents transverse puckerings. At the same time the right lobe is bent upon itself, the concavity of its lower surface being much increased. The hepatic tissue corresponding to the summit of the arch thus formed gradually wastes, until at last the lobe is divided into two portions by a deep transverse groove, which portions are connected merely by a membranous band, composed of thickened serous membrane, and the corresponding portion of the hepatic capsule.

Attention has of late years been directed to a condition of the liver analogous, in many respects, to that known as floating or movable kidney. The first case of this kind was put on record by Cantani, in 1866, and eight other instances have since been reported by Italian and German physicians. From the analysis of these cases given by Thierfelder, it seems to be quite clear, notwithstanding the absence of any confirmation by *post-mortem* observation, that a liver, normal in form and volume, and in all other respects perfectly healthy, may, under certain conditions of very rare occurrence, be capable of considerable displacement within the abdominal cavity. In the original instance published by Cantani, the organ lay entirely below the umbilicus, and part of it rested within the pelvis. There is much difference of opinion as to the ætiology of this condition. It occurs in most instances in women who have had many children, or who have been weakened by much hard work, and, from what is known at present of the condition, is probably due to the associated influences of a pendulous abdominal wall, and elongation, probably congenital, of the suspensory ligaments of the liver.

W. Johnson Smith.

LIVER, Morbid Growths of.—Several morbid growths have been met with in the liver, of which the following are the most important:—

1. **Non-parasitic Cysts.**—These formations are not often met with in the liver. There may be a single cyst, or a number of small cysts scattered throughout the organ. The single cyst is usually of small size, but in some instances—as in those recorded by Sir Benjamin Brodie, and in 1882 by Dr. Sharkey—may acquire very large proportions. The contents are fluid, in some cases stained by bile-pigments; in others quite clear and free from any trace of bile. This single cyst is, no doubt, very often a 'retention-cyst,' either of congenital origin, or the result of general interstitial hepatitis. Multiple cysts may also be due to dilatation of the bile-ducts, but in most instances they represent the condition known as cystic degeneration of the liver, which is regarded by pathological authorities in this country as the result of vacuolation or some other morbid change in the hepatic cells. The association of cystic disease of the liver with a similar condition of the kidney, the frequent occurrence of which renders very doubtful the conclusion that such is a simple coincidence, seems to indicate that the morbid conditions in these two organs are both of a similar nature, and due to a common cause. A condition much resembling that of multiple cysts in the liver, may, as has been shown by Dr. Hale White, be produced by *post-mortem* changes in this organ.

2. **Dermoid Cysts.**—Mr. Hulke has recorded an instance in which several dermoid cysts in a withered condition were found attached to the surface of the liver (*Trans. Path. Soc.* vol. xxiv. p. 157).

3. **Erectile Tumours.**—A hepatic erectile or cavernous tumour consists of a small red or bluish-red formation, of a more or less globular shape, of reticulated structure, and containing fluid blood or soft coagula. Growths of this nature are often multiple, and each of about the size of a filbert; they are usually found either along the anterior margin of the liver, or on the upper surface of the organ, near the attachment of the suspensory ligament. Each tumour is enclosed in a capsule of delicate connective tissue. Though seated at the periphery of the liver, an erectile tumour seldom projects beyond the surface of the organ. Much remains to be made out as to the pathological significance of these tumours, especially with regard to their relation to malignant disease. There is some difference of opinion as to their connexion with the hepatic vascular system. Virchow and Wilks hold that they are in communication with minute branches of the hepatic artery; whilst Frerichs states that they cannot be injected through this vessel or through the hepatic veins, but only through branches of the portal vein.

4. **Lymphatic Formations.**—The liver is sometimes found studded in all parts with minute patches of tissue of soft consistence, each patch being made up of an aggregation of lymphoid cells disposed in the meshes of a delicate reticulum. These patches of tissue are in close connexion with small vessels, from the walls of which, according to Frerichs, they are developed. This condition is associated with leukæmia.

5. **Tubercle.**—Tubercle, as met with in the liver, occurs only in the form of minute miliary granulations, scattered throughout the whole organ, but accumulated more especially on the surface. These growths have been rarely observed in the liver, and in most of the instances in association with acute general tuberculosis.

6. **Cancer.**—*See* Liver, Malignant Disease of.

7. **Hydatids.**—*See* Liver, Hydatid Disease of.

8. **Adenoma Hepatis.**—Under this title has been included a series of growths which, though all composed of imperfectly developed liver-tissue, differ very much from each other in pathological character, some remaining quite innocent, whilst others develop into intensely malignant and infective tumours.

9. **Benign Growths.**—Fibrous and other growths have been in rare instances found in the liver, but they do not give rise to any clinical signs.

W. Johnson Smith.

LIVER, Nutmeg.—Synon.: Fr. *Foie Noix de Muscade*; Ger. *Muskatnussleber.*—Nutmeg-liver consists in a chronic passive congestion of the organ, a state which may always be brought about when there exists any impediment to the circulation of the blood through the heart or lungs. The radicles of the hepatic vein become filled with blood, and thus the centre of each acinus shows a deep red, while the outer parts are either yellow or of natural tint. A nutmeg appearance is thus given to the liver, which is often shrunken and tough, with adherent capsule, and granular surface. Under the microscope the centre of the acinus is seen to be filled with dilated blood-vessels, which, pressing on the liver-cells, cause them to atrophy and undergo pigmentary degeneration, whilst in advanced stages of the disease they disappear altogether, and the centre of the acinus is made up of blood-vessels only, but there is no increase of the connective tissue in the same situation. The capsule of Glisson now and then takes on an over-growth, just as in cirrhosis; and the connective tissue between the lobule and around the vessels is considerably increased. It is to this overgrowth of the connective tissue that the shrinking and hardening of the liver are due.

Symptoms.—The liver may sometimes be felt during life under the ribs, more often not. It is sometimes tender on pressure. Slight jaundice is often present. The spleen is not enlarged, but is small—the opposite condition to that found in cirrhosis. Ascites is frequently present, especially in advanced cases. The urine is usually scanty, and contains bile. The skin generally has an icteric tint, and this, with a certain degree of lividity, produces a very characteristic appearance in the physiognomy of the patient.

Treatment.—This must be directed to the condition of the heart or lung upon which the obstruction to the circulation depends. Nutmeg-liver may always be suspected when there exists any impediment to the return of blood from the hepatic veins.

J. Wickham Legg. Stephen Mackenzie.

LIVER, Pigmentation of.—In subjects who have succumbed to intense malarious fever, and in some who during life had suffered from frequent attacks of intermittent or remittent fever in hot climates, the liver may be found stained by pigment, which may be diffused throughout the whole organ, or dispersed here and there in irregular patches. This pigmentation of the liver is always associated with a similar condition of the spleen, and frequently with staining of the nervous centres, the lungs, the kidneys, and the lymph-glands. Hepatic pigmentation is one of the chief *post-mortem* phenomena of the condition known as 'melanæmia,' in which the blood, especially that of the portal system, is pervaded by granules of pigment of a black or deep-brown colour, some of which are free and isolated, some held together in irregular masses by a pale jelly, and others enclosed in cells. In the pigmented liver these granules are to be found in the portal blood, in the walls of the capillaries, and outside the vessels, scattered amongst the hepatic cells, but not within these cells. In an early stage of the hepatic pigmentation the staining affects only the periphery of each lobule, but, as the disease progresses, the deposit gradually extends towards the centre, and then attacks the hepatic venous system. The arterial capillaries also contain similar pigment-granules.

Symptoms.—The size of the affected liver varies in different cases, and according to the severity and the stage of the disease. The organ is sometimes congested and swollen; it often remains of normal size; in some few instances it finally becomes atrophied. The main symptoms of this condition of the liver are occasional intestinal hæmorrhage, diarrhœa, and ascites. These symptoms in well-marked cases of melanæmia are usually associated with albuminuria due to pigmentary affection of the kidneys, and with more severe symptoms due to cerebral complications, such as delirium, coma, and paralysis. Melanæmia has been met with mostly in warm climates, and occasionally during severe epidemics of intermittent and remittent fever in some parts of the North of Europe. In this country it has been very rarely observed. *See* Blood, Morbid Conditions of.

Pigmentation of the liver has been observed in cases of pernicious anæmia, as a consequence of a deposit of a reddish-brown pigment containing iron in the hepatic cells and capillaries.

In cases of obstructive jaundice, the liver may be stained as a result of reabsorption by the cells of bile-pigment.

W. Johnson Smith.

LIVER, Syphilitic Disease of.—The liver occasionally becomes diseased during the tertiary stage of syphilis, or the period of gummy deposits, the hepatic affection being associated at some period with osseous and cutaneous lesions, and with syphilitic cachexia.

Anatomical Characters.—*Syphilitic hepatitis* may attack both the capsule (*perihepatitis*) and the internal prolongations or septa of the capsule (*parenchymatous hepatitis, syphilitic cirrhosis*). In some cases a small portion, in others a greater part or the whole of the organ is affected. In the milder form and less advanced stages of the disease the capsule is slightly thickened, and marked by a few isolated white patches, while the surface of the liver is here and there slightly grooved and indented. After prolonged inflammatory action the liver becomes much deformed, and is made up of a number of small lobes bounded by deep depressions, the parenchyma on section being found to be traversed by well-marked bands of tough and retractile connective tissue. The secretory structures of the liver do not undergo very much change in this disease; and, notwithstanding the retractile properties of the fibrous tissue forming the white bands, the vessels and ducts usually remain permeable. The liver-cells occasionally become loaded with fatty elements, and in some rare instances undergo albuminoid degeneration. In cases of syphilitic perihepatitis, the liver is almost always bound to the diaphragm, and sometimes to the adjacent viscera, by firm adhesions.

Formation of *gummy tumours*—'the encysted knotty tumours of the liver,' as they were named by Dr. Budd—occurs more frequently than syphilitic hepatitis, with which condition, however, it is often associated. In this form of syphilitic disease, the liver presents on section, especially in its deeper parts, a number of globular growths, more or less firm in consistence, of a yellowish-white colour, and varying from the size of a pin's head to that of a large walnut. A large deposit of this kind is usually soft or cheesy at its centre, and becomes more and more firm towards its periphery, where it is surrounded by a greyish and translucent zone of incipient connective tissue, which passes gradually into apparently healthy parenchyma. A full description of the minute structure of these hepatic gummy tumours will be found in a report by Dr. Payne on three specimens shown before the Pathological Society in 1870 (*Trans. Path. Soc.* vol. xxi. p. 207). In each tumour it was found that the soft central portion was composed of granular and almost amorphous material, in which were embedded certain round or irregular translucent bodies of large size, which probably represented collections of degenerated liver-cells. The soft central portion passed imperceptibly into fibro-nucleated structure. The surrounding fibrous zone was found to be composed of dense connective tissue, with crescentic and irregularly shaped interspaces, containing masses of fatty globules or granular matter. This fibrous structure was not strictly defined from the structure of the more central parts of the tumour, and on the outside passed into the interstitial connective tissue of the liver, and became converted into masses of nucleated tissue, each of which masses appeared to be formed around a small branch of the portal vein or hepatic artery. Dr. Payne supports the view held by Virchow concerning the pathogenesis of hepatic gummy tumours, and holds that the amorphous central portion is to be regarded, not as a deposit of tissue lowly organised from the first, but as fibrous tissue in a more or less advanced stage of involution and decay.

In cases of infantile syphilis, whilst hepatitis is not infrequent, gummata are very rarely met with.

Whether true *hepatic cirrhosis* may be caused by syphilis is open to doubt, since in most cases supposed to be of syphilitic origin it has been found impossible to exclude with confidence the idea of a probable alcoholic origin.

Albuminoid degeneration of the liver has not infrequently been observed in the subjects both of acquired and of inherited syphilis, and very often in syphilitic subjects who had not been previously affected with caries or necrosis of bone, with cutaneous ulceration, or with profound or prolonged suppuration. This condition of the liver, when associated with syphilis, is probably due rather to cachexia and debility than to any essentially syphilitic influence. The almost, if not quite, obsolete views that the amyloid disease is to be attributed to the action of mercury, or to the combined action of this medicinal agent and syphilis, are opposed by the facts that this condition of the liver has often been observed in a syphilitic fœtus, and also in adults who had not previously been treated with mercury, and never in non-syphilitic subjects of mercurial poisoning.

Symptoms.—The symptoms of syphilitic hepatitis and gummy tumours in the liver are in most instances obscure, so that these complications of advanced syphilis are often overlooked. The liver in some cases is enlarged, in other cases reduced in size. In the former instance it will often be found on abdominal percussion that the relative proportions of the right and left lobes have been much altered, and that there is considerable deformity of the whole organ. Firm globular elevations on the surface of the liver may sometimes be felt through the anterior abdominal wall. Advanced syphilitic hepatitis is usually associated with slight and slowly increasing ascites, and sometimes with œdema of the lower extremities. There is seldom any well-marked jaundice. The patient often complains of a sense of weight and uneasiness in the right hypochondrium, or, in some few cases, of severe pain. In almost all cases there is some hepatic tenderness. The most constant symptoms are of a dyspeptic character; the abdomen often becomes painful and distended; and there is very commonly, at an advanced stage of the disease, obstinate and profuse diarrhœa.

Diagnosis.—The slow progress of the disease; the absence of any severe pain in the region of the liver; a clear history of syphilis, and the presence of syphilitic lesions in some part of the body; no history of cancer; and the absence of any indications of malignant disease, whether on the surface of the body or in the abdominal cavity, all serve to support the diagnosis of syphilitic, as opposed to cancerous, disease of the liver. In ordinary cirrhosis of the liver the progress of the disease is more rapid; the dyspeptic symptoms are more severe; the ascites is more abundant; and the indications of alcoholism are generally well marked.

Treatment.—The treatment of syphilitic disease of the liver is that usually carried out in cases of tertiary syphilis.

W. Johnson Smith.

LIVER, Tubercular Disease of.—*See* Liver, Morbid Growths of.

LIVER-FLUKE.—A common name for the *fasciola*. *See* Entozoa.

LLANDRINDOD, in Radnorshire, South Wales. — Saline, sulphated, and chalybeate waters. *See* Mineral Waters.

LOBULAR (*lobulus*, a little lobe).—Of or belonging to a lobule. A term generally applied to morbid conditions affecting individual lobules of organs which are thus constituted, such as *lobular pneumonia*, *lobular pulmonary collapse*, and *lobular hepatitis*.

LOCAL.—This term is used in contradistinction to the word *general*. Thus, in connexion with *morbid conditions*, it is applied to those which are confined to, or seem specially to affect, a particular part. Again, *local causes* are such as act upon a limited portion only of the body, such as a blow or a burn. *Local treatment* implies the application of remedies in the same sense.

LOCK-JAW.—A popular synonym for tetanus. *See* Tetanus.

LOCOMOTOR ATAXY (*locus*, a place; and *moveo*, I move; ἀ, priv., and τάξις, order).—*See* Tabes Dorsalis.

LOECHE-LES-BAINS (LEUKERBAD), in Switzerland.—Thermal calcic waters and climatic health resort. *See* Mineral Waters.

LORDOSIS (λορδός, bent).—A term applied to abnormal curvature of the spine forwards. It is found chiefly in the lumbar region as an increase of the natural curvature; but it may also occur in the dorsal and cervical regions. *See* Spine, Diseases of.

LORETO, in the Romagna in Italy. Saline waters. *See* Mineral Waters.

LOS ANGELES, the capital of southern California. A health resort, 110 miles from the Pacific coast, in a well-sheltered fertile valley at an elevation of 371 feet. Famous for its orange and lemon groves. Pasaderra, a suburb, lies 500 feet higher, and is well supplied with hotel accommodation. Climate mild, but not marked by the degree of equability of temperature that characterises the Pacific stations. Mean temperature 61° F.; mean daily range 24° F.; and rainfall 15 inches.

LUCCA, in Tuscany.—Thermal waters containing sulphate of calcium with iron. *See* Mineral Waters.

LUCID INTERVALS. — No better definition of this state has been given than that of Lord Thurlow, who calls it 'an interval in which the mind, having thrown off the disease, had recovered its general habit.' It must be regarded as extremely unlikely that a perfect restoration to reason can take place in the course of any long-continued insanity, without full opportunity having been afforded of testing its nature. The law more readily recognises the restoration of the mind to a state of civil capacity such as will render testamentary acts valid, than such temporary recovery as would restore responsibility for crime. If a civil act be rationally performed, the law accepts that as *primâ facie* proof of the capacity of the agent; but juries very seldom convict the accused of a crime if insanity is proved to have existed within a short period of its commission.

John Sibbald.

LUHATSCHOWITZ, in Moravia.—Muriated alkaline waters. *See* Mineral Waters.

LUMBAGO (*lumbi*, the loins).—Synon.: Fr. *Lumbago*; Ger. *Lendenweh.*—Muscular rheumatism affecting the muscles and fasciæ of the lumbar region. *See* Rheumatism, Muscular.

LUMBAR ABSCESS. — An abscess, generally of spinal origin, occupying the lumbar region, or pointing in the loin external to the erector spinæ. *See* Psoas Abscess.

LUMBAR REGION.—Anatomically this region is limited above by the 'sub-costal' line round the trunk, at the level of the lowest point of the tenth costal arch, which cuts the body of the third lumbar vertebra near its upper surface; below by the intertubercular line (Cunningham), running through the tubercles on the outer lips of the iliac crests, $1\frac{1}{2}$–2 inches back from the anterior superior spines; towards the mid-line by a sagittal section through the centre of Poupart's ligament (mid-Poupart line), which cuts the ilium behind about half an inch outside the sacro-iliac synchondrosis. We thus get mapped out a region which has somewhat the shape of half a cylindrical cone tapering upwards. It includes more than the upper inch of the iliac fossa; it does not include the triangular area between the sub-costal line and the lower edges of the tenth, eleventh, and twelfth ribs as they slope up to the spine. Clinically, the lumbar region extends up to these ribs, and down only to the iliac crest.

The *viscera* contained in this region are few. The kidney barely descends below the sub-costal line, but a large part of it lies below the last rib. Rather more of the right kidney than of the left will lie in the lumbar region. Crossing the front of the lower half of the left kidney is the tail of the pancreas. Taking a fairly vertical course through the region, just external to the lower part of the kidney is the colon (right or left); and the beginning and ending of the transverse colon cross the front of the right and left kidney respectively, lying on the latter just below the pancreas. More or less of the small intestine fills up any gaps left. Viewed from the front, all viscera above the lower ends of the kidneys would be regarded clinically, as well as anatomically, as in the hypochondriac regions. The *peritoneum* surrounds the ascending colon almost completely, but usually leaves a considerable surface (widening with distension of the bowel) uncovered on the descending colon; this surface and the meeting of the inner and outer layers of the ascending meso-colon lie on the posterior and inner aspect of the bowel. The inner layer, as it passes from the colon towards the mid-line, covers the lower end of the kidney and, mounting thence, surrounds the transverse colon and covers the front of the right kidney, but is kept from the pancreas and most of the left kidney by the intervention of the small bag. Outside the peritoneum is the sub-peritoneal *fat*, which varies greatly in amount, and which becomes more solid and suet-like where it surrounds the kidney (peri-renal fat). Outside this is the transversalis *fascia*, always delicate, but better marked in thin than in fat subjects. Next come the *muscles*. The quadratus lumborum, 2–3 inches wide, extends from the crest to the lower edge of the last rib, lying just outside the lumbar transverse processes, to which it is attached. It is contained within an aponeurotic sheath, of which the posterior and stronger layer, attached to the tips of the transverse processes, is the posterior tendon of the transversalis. The anterior layer is attached to the fronts of the same processes, and blends outside the quadratus with the posterior layer, which forms a tendinous band half an inch wide outside the edge of the quadratus, from which the fibres of the transversalis spring and pass horizontally forwards. Whilst the posterior layer of the quadratus sheath is attached, like the muscle, to the crest and last rib, the anterior layer is continuous with the external arched ligament of the diaphragm, which extends from the first lumbar transverse process to near the tip of the last rib. From this band, fibres of the diaphragm rise, and between the diaphragm and the upper end of the quadratus there is usually a short duplicature of pleura. Overlapping the front of the quadratus to a slight extent, especially below, is the psoas muscle, in the substance of which is the lumbar plexus. On the dorsal aspect the erector spinæ extends farther out than the psoas over the quadratus; it is bound down by a strong layer of fascia (vertebral aponeurosis) which blends externally with the posterior tendon of the transversalis. This lamina and the layers of the quadratus sheath are the posterior, middle, and anterior layers of the fascia lumborum. Between the edge of the erector and the muscle of the transversalis is the posterior tendon of the transversalis, an inch or so wide, having the quadratus beneath its inner half. Arising from the anterior two-thirds of the middle area of the crest, and from the transversalis tendon between the crest and the erector, is the internal oblique muscle, which runs upwards and forwards to the tip of the last rib. Again superficial to this, arising from the outer surfaces of the lower ribs and often from the transversalis tendon between the last rib and the erector, is the external oblique, which runs downwards and very slightly forwards, to the outer lip of the crest at and in front of the middle. Crossing the very angle between the last rib and the erector is the lowest digitation of the serratus posticus superior, running up and out; its tendon blends with the vertebral aponeurosis beneath it and the tendon of the latissimus superficially. Lastly, the latissimus springs along an oblique line from a wide aponeurosis attached to the sacral, lumbar, and lower dorsal spines, and to the outer lip of the crest almost to the middle, and blended with the subjacent serratus tendon and vertebral aponeurosis. The muscular fibres pass upwards and forwards, overlapping those of the external oblique, except at the crest, where a small space (Petit's triangle) is usually left between the edges of the two muscles and the crest, and having the internal oblique for its floor. The subcutaneous tissue is firmer, more fibrous, and in smaller quantity over the erector than elsewhere; hence, the very thick skin of the part is less freely movable over the erector than farther forwards.

The *vessels* of the region are the lumbar, five in number, running out behind the quadratus into the interval between the transversalis and internal oblique; but the first lumbar artery lies in front of the quadratus.

The *nerves* in the area are the last dorsal, which, accompanied by the first lumbar artery, runs very obliquely from below the twelfth rib downwards in front of the quadratus, through the posterior layer of its sheath, into the interval between the transversalis and internal oblique to a little above the iliac crest near its middle, where it gives off a lateral cutaneous twig to the buttock, and then passes in, to end near the mid-line. Next we find the ilio-hypogastric and ilio-inguinal, issuing from the side of the psoas high up, crossing the quadratus, piercing the transversalis just outside the quadratus and near the anterior spine respectively, and running on between the muscles of the wall.

Surface-marking.—Looked at either from the front or from the back, the outline of the lumbar region is concavo-convex from above down—the concavity above being that of the natural waist, below the ribs, the convexity below being due to the bulging of the broad muscles of the abdomen over the iliac crest, which lies at the bottom of a slight groove bounded by the above muscles and those of the hip. In front, the upper part of the linea semilunaris may lie in the region. Outside this the surface varies much in form with the fatness and muscularity of the individual; generally it is slightly convex in all directions. Behind, the thick rounded edge of the erector spinæ is seen; and outside this there is a distinct depression, which can be felt when it cannot be seen. The colon lies just outside the erector beneath a vertical line dropped through a point half an inch behind the middle of the crest. In thin and muscular subjects an oblique line running from about this spot up and in towards the lower dorsal spine may mark the origin of the fibres of the latissimus from the aponeurotic tendon.

This region is of much importance, for the kidney, the ascending or the descending colon, and the psoas muscle are reached through it. Through Petit's triangle an abscess or a hernia may point. STANLEY BOYD.

LUMBRICUS.—By many practitioners this term is still employed to designate the large round-worm (*Ascaris lumbricoides*). The title is entirely a misnomer, having originated with Tyson (*Phil. Trans.* 1683), who called the common species *Lumbricus teres hominis*. All the larger round-worms infesting man and animals are apt to be called lumbricoids. Notwithstanding their general resemblance to ordinary earth-worms, their organisation is totally different. Occasionally, in practice, patients seek to deceive the medical attendant, by placing one or more earth-worms in the night-stool or chamber-pot. The writer once encountered an instance where a large garden lobworm (*L. terrestris*), about a foot in length, had been carefully selected for this purpose. The practitioner should not only be familiar with the differences of character presented by true and false worms of this kind, but should bear in mind that earthworms cannot live in the human bladder and intestines. *See* ENTOZOA.

T. S. COBBOLD.

LUNACY, Law of.—The medical practitioner is frequently required to perform duties in connexion with lunacy, the satisfactory discharge of which requires that he should have some acquaintance with the legal enactments by which they are regulated. The statutes differ slightly in the three divisions of the kingdom. It will therefore be necessary, after describing what is required under the law in England, to show where its requirements differ from those which exist in Scotland and Ireland. The details to be given here will only include what is necessary for the information of the general practitioner. Anyone who intends to devote himself specially to the treatment of the insane, or to receive one or more persons of unsound mind into his house, must comply with regulations which we cannot here set forth, but which are fully described in works upon the subject. When a person living in his own home is under treatment for insanity, the medical attendant is justified by the common law in adopting any measures of restraint which may be necessary for safety or the proper treatment of the malady. This has been decided by the courts of law in recent cases. If, however, it is proposed to place the patient in an asylum, or under the charge of any person who is to derive profit either directly or indirectly from the proceeding, it is necessary that certain forms should be carefully observed.

In the case of a *Chancery lunatic*, the patient may be taken charge of by his 'Committee of the Person,' or he may be received into an asylum or other institution for lunatics, or into a private house, on an order by the committee. Such an order must, however, have annexed to it an office copy of the appointment of the committee. If no committee has been appointed, an order by a Master in Lunacy is sufficient authority for the detention of the lunatic.

In the case of *other private patients*, it is necessary, under the Lunacy Act of 1890, to have a *reception order* made by the 'judicial authority.' The judicial authority under the Act is either a judge of county courts, a stipendiary magistrate, a metropolitan police magistrate, or a justice of the peace specially appointed for such duty, having respectively jurisdiction in the place in which the patient is. This order is obtained by private application upon a *petition*, accompanied by a *statement of particulars* and by two medical *certificates*. These must be made in the forms prescribed by statute.[1]

THE PETITION.—This document must be

---

[1] These forms can be obtained at the law stationer's; but, as they are frequently wanted with the least possible delay, we mention the names of Messrs. Shaw & Sons, Fetter Lane, E.C., and of Messrs. Knight & Co., 90 Fleet Street, E.C., as firms in the habit of supplying them.

signed, if possible, by the husband or wife, or by a relative, and, if not, it must contain the reasons for its being signed by another person, and a statement of the connexion of that person with the patient. The person signing the petition must be at least twenty-one years of age, and must have seen the patient within fourteen days of the date of presenting the petition. If a petition for a reception order has been previously presented in regard to the patient, and has been dismissed, the facts relating thereto must be stated in the petition; and there must be presented along with it a copy, to be obtained from the Commissioners in Lunacy, of the statement received by the commissioners of the reasons for such dismissal. If one of the medical certificates is not given by the usual medical attendant on the patient, the reason for this must be stated in the petition. And if an urgency order (hereafter described) has been made in regard to the patient, it must be referred to in the petition. No member of the managing committee of a hospital can sign the petition for the reception of a patient into that hospital.

The Medical Certificates.—One of the medical certificates must, whenever practicable, be by the usual medical attendant on the patient. Each certificate must be on a separate sheet of paper, and each person who signs a certificate must have separately examined the patient not more than seven days before the presentation of the petition, and must be a person registered under the Medical Act, 1858, and in actual practice. Certain persons are disqualified for signing either of these certificates or the certificate required in support of an urgency order. These are: The petitioner, or the person signing the urgency order, or the husband or wife, father or father-in-law, mother or mother-in-law, son or son-in-law, daughter or daughter-in-law, brother or brother-in-law, sister or sister-in-law, partner, or assistant of such petitioner or person. The statute also forbids the following persons from signing certificates: The manager of the institution into which the patient is to be received, the person who is to have charge of the patient as a single patient, any person interested in the payments on account of the patient, any regular medical attendant in the institution, or the husband or wife, father or father-in-law, mother or mother-in-law, son or son-in-law, daughter or daughter-in-law, brother or brother-in-law, sister or sister-in-law, or the partner or assistant of any of these persons. Again, neither of the persons signing the certificates can be the father or father-in-law, mother or mother-in-law, son or son-in-law, daughter or daughter-in-law, brother or brother-in-law, sister or sister-in-law, or the partner or assistant of the other of them. And no member of the managing committee of a hospital can sign a certificate in the case of a patient to be received into that hospital.

The Reception Order.—The judicial authority may, upon the presentation of the petition and certificates, make the reception order forthwith; or, if the certificates are not regarded as satisfactory, or for any other reason, he may appoint a time, not more than seven days after the presentation of the petition, for its consideration, and may, if he thinks necessary, visit the patient. The petition is then considered in private, and no one except the petitioner, the alleged lunatic (unless the judicial authority otherwise order), any one appointed by the alleged lunatic for that purpose, and the persons signing the medical certificates—all of whom are bound to keep secret the matters disclosed—can, without leave of the judicial authority, be present. A further adjournment for not more than fourteen days may then be made for further inquiry if the judicial authority shall think fit, after which he either grants the order or dismisses the petition. A reception order is sufficient authority for the person signing the petition, or some one authorised by him, to take the patient and convey him to the place mentioned in the order; but it does not continue in force unless the patient is received in the asylum or house within seven days of its date, except when the execution of the order has been suspended by reason of a medical certificate that the lunatic is not in a fit state for removal—in which case the order continues in force for fourteen days, unless a subsequent certificate is given that the patient is fit for removal, and in that case the order remains in force only for three days after the date of that certificate.

The Urgency Order.—If the necessity for placing a patient in an asylum or house is regarded as urgent, an order, called an 'urgency order,' may be signed as in the case of the petition by a husband or wife, or by a relative; and, if signed by another person, the reason for this must be stated, and also the connexion of that person with the patient. The person signing must be at least twenty-one years of age, and must have seen the patient within two days of the date of the order. This order must be accompanied by a statement of particulars similar to the statement of particulars which is required to accompany the petition, and by a medical certificate stating that it is expedient for the welfare of the patient, or for the public safety, that the patient should be forthwith placed under care and treatment. The certifier in this case must have seen the patient not more than two days before his reception. An urgency order is sufficient authority for a person, authorised by the persons making the order, taking the patient and conveying him to the place mentioned in the order, and it remains in force for his detention for seven days from the date of the order; or, if a petition has been presented, it remains in force till the petition has been disposed of. An urgency order may be made either before or after a petition has been presented; but, if made before, it must be referred to in the petition, and, if made after, a copy of it must be sent forthwith to the judicial authority to whom the petition has been presented.

The information contained in the foregoing paragraphs indicates sufficiently for the purposes of the general practitioner the steps which require to be taken for placing a person of unsound mind under care and treatment. It is of the greatest importance, however, in filling up the several forms, that the most scrupulous attention should be given to the marginal notes which are attached to the forms. Great care must be taken to ensure that the instructions contained in these marginal notes are complied with in every, even the smallest, detail. For it may happen that what may appear to many to be a trifling deviation from the instructions, will render the document invalid, and thus entail much inconvenience and distress. In regard to the medical certificates, it should be kept in view that the persons who sign them must arrive at opinions in regard to two questions which are quite distinct. Each certifier has first to determine whether the patient is of unsound mind, and, next, whether it would be proper to place him under detention. In stating the facts, it must be borne in mind that they must be such as will appear to the judicial authority making the reception order sufficient evidence of insanity. Great care must be taken to state the facts both intelligently and accurately. There must be sufficient in the facts observed by the medical man himself to justify the opinion to which he certifies. A certificate founded solely on information obtained from others is invalid, and such information should be regarded by the certifier as useful merely to corroborate his opinion. It must also be kept in view that the opinion must be directly deducible from examination of the patient on the particular day and at the particular place specified. The statement of facts observed should therefore contain at least one statement of a fact, or combination of facts, which could not be made in regard to a person of sound mind. A frequent error is the stating of the facts in such an imperfect manner that, though they may have been sufficient indications of insanity as observed, the manner in which they are recorded makes them appear to be insufficient. It is sometimes stated, for example, that a patient 'believes himself to be possessed of great wealth'—without adding that this is an erroneous belief. Another kind of failure to state the facts intelligently is illustrated by an actual instance where they were given thus: 'His appearance, manner, mode of speaking, as well as his conduct.' These were probably quite adequate to prove to the certifier that the patient was insane, but it is obvious that they afforded no proof to those who merely read the statement.

If a lunatic, who is not a pauper, and not wandering at large, is not under proper care and control, or is cruelly treated or neglected by any relative or other person having the care or charge of him, information should be given to a constable of the district or a relieving officer or overseer of the parish, who is bound within three days to take steps, prescribed by statute, to have him placed in an institution for lunatics.

The duties performed by medical men and others in connexion with the placing of patients under care and treatment have been frequently the source of great trouble and expense, from legal proceedings taken against them by patients or others who have felt themselves aggrieved. In order to afford protection against such action, when improperly taken, it is provided in the Lunacy Act of 1890 that a petitioner or certifier 'shall not be liable to any civil or criminal proceedings, whether on the ground of want of jurisdiction or on any other ground, if such person has acted in good faith and with reasonable care.' If such proceedings are taken, they 'may, upon summary application to the High Court of Justice or a judge thereof, be stayed upon such terms as to costs and otherwise as the court or judge may think fit, if the court or judge is satisfied that there is no reasonable ground for alleging want of good faith or reasonable care.' Even under the protection afforded by this enactment, it will be understood that both expense and trouble may be occasioned by vexatious proceedings, as the steps necessary to get proceedings stayed by the High Court may involve considerable outlay.

Anyone who makes a wilful misstatement of any material fact in any petition, statement of particulars, or medical certificate, is guilty of a misdemeanour; but no prosecution for such misdemeanour can take place except by order of the Commissioners in Lunacy, or by the direction of the Attorney-General or the Director of Public Prosecutions.

A private patient may be discharged from the asylum or house in which he has been detained on the written authority of the person on whose petition the reception order was made, or, if this person is dead or incapable, by the person who made the last payment on account of the patient, or by the husband, or wife, or next-of-kin. If a patient should die while under detention, it is necessary to give notice of the death to the coroner and to the Commissioners in Lunacy.

In the case of *pauper lunatics*, the procedure is somewhat different from that required for private patients. Anyone aware of the existence of an insane pauper in a parish ought, if the case is a proper one for treatment in an institution for lunatics, to give notice to the relieving officer or the overseer. When a district medical officer under the poor-law becomes aware of such a circumstance, it becomes his statutory duty to give this notice in writing within three days after obtaining such knowledge. The relieving officer or overseer may then take steps to have the patient placed in an institution for lunatics upon one medical certificate, accompanied by the order of a justice of the peace, if the justice is satisfied that the alleged pauper is either in receipt of relief, or in such circumstances as to require relief for his proper care.

In order to place either a private or a pauper patient in an asylum in *Scotland*, a petition, accompanied by a statement and two medical certificates, has to be presented to the sheriff.[1] In the case of a private patient, the person signing the petition must state the degree of kinship or other relation in which he stands to the patient. In the case of a pauper, the petition must be signed by the inspector of the poor. In either case, if there be reasonable ground for so doing, the patient may be placed in the asylum on what is called a 'certificate of emergency,' signed by one medical man. If, however, the order of the sheriff is not obtained within three days thereafter, the patient must be discharged. In the case of a patient placed for profit in a private dwelling-house in Scotland, the fact must be reported to the General Board of Lunacy for Scotland, and the sanction of the Board obtained.

The procedure required for placing a patient in an asylum in *Ireland* resembles that which is required in England. For admission to a private asylum, an order and two medical certificates must be filled up and signed, subject to regulations resembling those already described as enforced in England; but the facts indicating insanity do not require to be stated in the certificates. Pauper patients are placed in district asylums, and are admitted to these institutions on application being made at the asylum of the district in which the patient resides. The necessary form is obtained at the asylum. It consists of (1) a declaration to be made before a magistrate that the patient is insane and destitute, and has no friend able or willing to pay for his board in an asylum; and to this is annexed a statement descriptive of the patient; (2) a certificate by a magistrate, and a clergyman or poor-law guardian, in corroboration of the declaration; and (3) a medical certificate of insanity. When these forms have been filled up, it is necessary to wait until it is notified to some of the friends of the lunatic that there is room for him at the asylum. The procedure specially designed for the committal of dangerous lunatics is, however, frequently adopted in placing paupers in asylums; but this is a course which ought to be avoided, and which the medical practitioner ought specially to discourage. According to this procedure, the patient requires to be apprehended by the police, and brought before two justices of the peace. These call to their aid the medical officer of the dispensary district, and either discharge the patient or order his removal to the asylum. Patients who are not destitute, but whose friends are unable to pay the rates of board charged in private asylums, are received into district asylums at low rates, upon application being made at the asylum in a similar manner to that already described for paupers. The chief difference between the two forms is that, in the case of patients not destitute, the medical certificate requires to be signed by two medical men instead of only by one.

JOHN SIBBALD.

LUNATIC (*luna*, the moon).—SYNON.: Fr. *Lunatique*; Ger. *Mondsüchtig*.—A designation given to persons suffering from mental disorder, because such subjects were formerly believed to be peculiarly affected by lunar influences. The term is used popularly as synonymous with insane. In medical literature it is seldom employed, but the legal relations of the word are important. The adjective 'lunatic' is also used to signify that the object with which it is associated is connected with insanity, as *lunatic asylum*. *See* INSANITY.

LUNGS, Diseases of.—SYNON.: Fr. *Maladies du Poumon*; Ger. *Krankheiten der Lungen*.—Under this title there will be described in the following pages, with certain exceptions, the various morbid conditions which affect the pulmonary organs. Pulmonary phthisis is so common a disease, so complex and variable in its pathology, and so closely associated in its ætiology and symptoms with the entire organism, that it will be most conveniently described apart from the other diseases of the lungs (*see* PHTHISIS). Certain other diseases which involve the lungs, if not the lung-tissue proper, and which in some nosological systems are described as pulmonary diseases—namely, asthma, diseases of the bronchi, and diseases of the pleura—will also be found described apart from the present connexion, and under their several headings. Again, disorders of respiration, such as dyspnœa, orthopnœa, and 'Cheyne-Stokes respiration,' although frequently associated with diseases of the lungs, are in other instances referable to some morbid condition of other parts, such as the blood, the heart and circulation, or the nervous apparatus of breathing, and they will therefore be discussed in a distinct article (*see* RESPIRATION, Disorders of). The more important special clinical phenomena of disease of the lungs—namely, cough, expectoration, hæmoptysis, and the various physical signs—also demand more detailed and complete consideration than can be devoted to them in connexion with the various pathological conditions to which they are due. *See* COUGH; EXPECTORATION; HÆMOPTYSIS; and PHYSICAL EXAMINATION.

---

[1] The regular printed forms for Scotland may be obtained from Messrs. T. & A. Constable, 11 Thistle Street, Edinburgh.

After the separation of these subjects from that of diseases of the lungs, there remain for consideration under this head a large number of morbid conditions, which rank as of the first importance in practical medicine, and which will now be enumerated. The morbid processes which affect the lungs may be readily divided into two great groups—namely, first, those which are not essentially different from similar processes in other parts of the body; and, secondly, those which are quite peculiar to these organs.

First, with respect to the former group, the lungs, like the other great viscera, may present any of the ordinary morbid conditions which affect either entire organs, or the several tissues of which they are composed. Thus, the lungs may be the subject of various injuries, leading to *perforation* or *rupture*, and may present certain *malformations* and *misplacements*. They may undergo such alterations of nutrition as end in *atrophy*, *hypertrophy*, or certain *degenerations*. Disturbances of circulation give rise to well-defined pathological conditions, such as *anæmia*, *congestion*, *hyperæmia*, '*apoplexy*,' *embolism*, *infarction*, *œdema*, and *hæmorrhage*. The inflammatory process leads to a greater variety of pathological changes in the lungs than in perhaps any other organ, and which are known as *catarrhal*, *croupous*, and *chronic pneumonia*, *abscess*, *cirrhosis*, *gangrene*, and some forms of *phthisis*. *Morbid growths* of all kinds, including *malignant disease*, may involve the lungs, whether primarily or secondarily. *Syphilis*, besides actually involving the lungs, occasionally determines or modifies the occurrence of other pathological processes within them. Various *parasites*, especially *hydatids*, are occasionally tenants of the pulmonary organs.

Secondly, the morbid conditions which are *peculiar* to the lungs are such as depend upon their special structure, relations, and functions. Thus the relation between the pulmonary tissue and the pressure within and around the lungs may be so disturbed as to lead, on the one hand, to *collapse* or *compression*, or, on the other hand, to *emphysema*. Their communication with the atmosphere, and the constant interchange that is going on between the contents of the lungs and the external air, have an important influence upon the origin, distribution, progress, and treatment of many of the diseases which affect them; whilst the length and complexity of the respiratory passages, and their liability to disease, lead to many disturbances of the pressure, the circulation, and the nutrition within the lungs, and thus to collapse, hyperæmia, inflammation, and even destructive disease. The relation of the lungs to the circulation has an equally important influence upon them from a pathological point of view. Constituting as they do the channel of communication between the right and the left sides of the heart, the pulmonary vessels are involved in all the disturbances which affect the cardiac circulation, whether due to actual disease of the valves or of the walls, or to simple functional derangement of that organ. Congestion, œdema, embolism, infarction, hæmorrhage, and some forms of inflammation of the lungs, are the ordinary results of such circulatory disturbance of a temporary kind; and when it is more protracted, *brown induration*, as well as diseases of the bronchi and pleura, are likely to result.

Such are the principal conditions which determine and influence diseases of the lungs; and we shall here enumerate these in the alphabetical order in which they will be found referred to in the following pages: (1) Abscess. (2) Albuminoid Disease. (3) Anæmia. (4) Apoplexy. (5) Atrophy. (6) Brown Induration. (7) Cancer. (8) Cirrhosis. (9) Collapse. (10) Compression. (11) Congestion. (12) Consumption. (13) Degenerations. (14) Embolism. (15) Emphysema. (16) Gangrene. (17) Hæmorrhage. (18) Hydatids. (19) Hyperæmia. (20) Hypertrophy. (21) Induration. (22) Infarction. (23) Infiltrations. (24) Inflammation—Croupous, Secondary, Catarrhal, and Chronic. (25) Inflation. (26) Malformations. (27) Malignant Disease. (28) Malpositions. (29) Morbid Growths. (30) Œdema. (31) Perforation. (32) Rupture. (33) Syphilitic Disease; and (34) Tuberculosis.

LUNGS, Abscess of.—SYNON.: Fr. *Abcès du Poumon*; Ger. *Lungenabscess.*

DEFINITION.—Circumscribed suppuration of the pulmonary tissues.

ÆTIOLOGY AND PATHOLOGY.—An acute *primary* inflammation of the lungs may occasionally lead to the formation of abscess. Much more commonly, however, pulmonary abscesses are the result of *secondary* inflammations, and they are then, for the most part, associated with pyæmia.

Of acute *primary* inflammations of the lung, as causes of abscess, we have to consider those due to mechanical injuries, and those associated with acute pneumonia and with gangrene. With regard to the former, it is only necessary to remark that mechanical injuries, such as fractured ribs, penetrating wounds of the thorax, the lodgment of foreign bodies, &c.,

may cause suppuration, and so occasionally lead to the formation of abscess. That acute pneumonia may, in rare cases, terminate in abscess of the lung, has already been stated. Such a result appears to be favoured by a bad constitution, and by any circumstances which tend to impair the general health, especially the abuse of alcohol. The abscess is more common in the upper than in the lower lobes. Lastly, circumscribed gangrene of the lung occasionally terminates in abscess. This takes place by the expulsion of the necrotic tissue through the bronchi, and the formation of a pyogenic membrane from the walls of the cavity, which generates pus. The cavity may ultimately close by granulation and cicatrisation. Abscesses of primary origin are usually single.

Secondary abscesses of the lung owe their origin to the dissemination of infective substances by means of the blood-vessels or lymphatics, and are usually pyæmic. The secondary abscesses are of two kinds—those which follow upon infarction, and those in which there is no evidence of such antecedent change. These abscesses are almost invariably multiple. They vary in size from a pin's head to a walnut, and are usually most abundant near the surface. They are commonly surrounded by a thin zone of dark red consolidation; and, when adjacent to the pleura, this membrane over them is always inflamed. Pulmonary abscesses may also result from the aspiration of putrid substances into the bronchi, as is common after operations on the mouth, nose, and trachea. *See* LUNGS, Inflammation of: C. Broncho-Pneumonia.

SYMPTOMS AND PHYSICAL SIGNS.—The formation of abscess in the lung is rarely attended by any marked clinical phenomena, the symptoms of the disease in the course of which the localised suppuration takes place being, for the most part, but little modified by its occurrence.

When acute pneumonia terminates in abscess, either the rapid fall of the temperature which constitutes crisis does not occur, or, what is more common, its occurrence is followed by pyrexia of an irregular type. The physical signs of consolidation also persist, and there is usually great prostration. Sometimes, owing to the opening of the abscess into a bronchus, pus is coughed up; and then, if the communication with the bronchus remain free, signs of cavity may be discoverable. Before such partial evacuation of its contents, the detection of the abscess by physical examination is usually impossible. The expectoration of sputa containing large quantities of pus, and often a little blood, may continue for some weeks; the signs of prostration may gradually increase; and death may ensue in the course of from two to three months, and often earlier. Partial or complete recovery may, however, take place, the cavity becoming quiescent and secreting only diminishing quantities of pus; and complete cicatrisation may ultimately occur. In exceptional cases the abscess opens into the pleural cavity.

Abscesses of the lungs occurring in the course of pyæmia rarely give rise to any special symptoms or physical signs. They are usually much smaller than primary abscesses; and death commonly ensues before any of them have attained sufficient magnitude to influence the general phenomena of the disease.

DIAGNOSIS.—The diagnosis of abscess, occurring in the course of pneumonia, rests mainly upon the persistence and characters of the pyrexia; upon the physical signs of excavation supervening on those of pulmonary consolidation; and upon the expectoration of sputa containing pus. Pyæmic abscesses rarely admit of diagnosis. Their existence may be suspected if, in cases of pyæmia, pleural friction-sounds are audible over different portions of the chest.

PROGNOSIS.—Abscess resulting from pneumonia very commonly proves fatal in from one to three months; it may, however, as already stated, ultimately terminate in partial or even complete recovery. The development of abscesses in the lungs in the course of pyæmia does not appear to influence the general prognosis.

TREATMENT.—Abscesses of the lungs rarely admit of any special treatment. Their occurrence, however, indicates the importance of doing all that is possible to maintain the strength of the patient.

T. HENRY GREEN.

LUNGS, Albuminoid Disease of.—In advanced cases of albuminoid disease, the lung-tissues may present more or less of this morbid change. It is of no practical importance, for it does not give rise to any evident symptoms, nor does it appear to have any specially injurious effect upon the patient.

LUNGS, Anæmia of.—SYNON.: Fr. *Anémie du Poumon*; Ger. *Lungenanämie.*

DEFINITION.—A deficiency of blood in the lungs, which may be *general* or *local.*

ÆTIOLOGY.—Besides hæmorrhage and the other causes of general bloodlessness, there are certain local causes which produce anæmia of the lung. In senile atrophy and in pulmonary vesicular emphysema, anæmia is associated with destruction of capillaries. Local or partial anæmia of the lung is the immediate result of embolism of the branches of the pulmonary artery. It rarely happens that the main vessel is entirely obstructed by an embolus; but it, or more commonly one of its main divisions, may be compressed or obliterated by the invasion of a malignant growth or aneurysm. Aneurysm of a branch of the pulmonary artery within the lung usually causes anæmia of the portion to which the vessel is distributed.

ANATOMICAL CHARACTERS.—In extreme anæmia, as after death from hæmorrhage, the lungs and the bronchial mucous membrane are exceedingly pale from absence of blood. They are of course lighter in weight than natural, but in other respects unchanged. In the general disease known as anæmia, the lung partakes with other organs of the general deficiency of red blood; but in this condition, it being not so much in quantity as in quality that the blood is deficient, the lungs are of normal weight, but paler and more moist than natural, sometimes slightly œdematous.

EFFECTS.—The consequences of pulmonary anæmia, when long-continued, are atrophy of its texture, as in senile atrophy and vesicular emphysema, and in local deficiency of blood from partial obstruction of a large branch of the pulmonary artery. In complete obstruction of vessels from embolism, death and sloughing of the deprived area of lung is the consequence. The sudden arrest of circulation through a limited portion of the lung gives rise to stress on the collateral circulation, the result of which is often hæmorrhage. Orth asserts that continued anæmia of lung favours the occurrence of phthisis, and attributes the proneness of the apices to attack by tubercle to their relative anæmia; he also draws attention to the tendency of people with stenosis of the pulmonary artery to succumb to phthisis (*Lehr. d. Path. Anat.*, Bd. i. p. 374).

SYMPTOMS.—The dyspnœa and palpitation observed in anæmia are traceable to the anæmic condition of the lungs, and have their *rationale* in the necessity for an increased diligence of respiration, to enable the diluted blood to gather sufficient oxygen for carrying on the various combustion-processes of life. The remarkable gasping and restlessness seen in cases of fatal hæmorrhage, are really the signs of asphyxia from pulmonary deprivation of blood. The symptoms of general or local pulmonary anæmia, dependent upon emphysema, embolism, &c., are lost in those of the more important diseases.

TREATMENT.—There is no special treatment for pulmonary anæmia.

R. DOUGLAS POWELL.

LUNGS, Apoplexy of.—A synonym for extravasation of blood into the lungs. *See* LUNGS, Hæmorrhage into.

LUNGS, Atrophy of.—SYNON.: Senile Emphysema; Fr. *Atrophie du Poumon*; Ger. *Lungenatrophie*.

DEFINITION.—A wasting of the constituent elements of the lungs, from defective nutrition.

VARIETIES.—Atrophy of the lungs may be—(*a*) *general*, in which all the tissues of the whole of both lungs are wasted, as in senile atrophy; (*b*) *local*, in which all the tissues of a portion of the lung are wasted, as in the atrophy that results from a local diminution of blood-supply; or (*c*) *partial*, in which some of the tissues are atrophied coincidently with increased growth of other tissues, as in some cases of so-called 'hypertrophous emphysema,' and in 'cirrhosis' of the lung.

ÆTIOLOGY.—The cause of simple atrophy of the lungs is that general failure of nutrition which is natural to advanced age. Hereditary predisposition may determine an earlier failure of nutritive change in the lungs. The strongly marked tendency of vesicular emphysema to recur in successive generations is certainly in favour of such a tendency to premature impairment of tissue being inherited.

Over-stretching of the walls of the air-cells in emphysema, with the consequent impediment to circulation, is an important cause of subsequent atrophy in this disease. Collapse and anæmia of lung—from pressure from without, or from the pressure of a growth or aneurysm upon one of the pulmonary vessels, cutting off the blood-supply, or on a large bronchus, diminishing the respiratory function—may cause atrophy of the whole or of a part of one lung.

ANATOMICAL CHARACTERS.—The appearance of an atrophied lung may be best seen in a case of natural or senile atrophy. The organ is small, light, anæmic, more or less deeply pigmented, drier in texture and less firm and resisting than natural, pitting on pressure from want of elastic resilience, and capable of being squeezed into a very small compass. The air-cells appear to be increased in size; and at some portions, if the lung be inflated and dried, large cells may be seen, evidently resulting from the coalescence of two or more infundibula. Across such cells filaments may extend the remnants of small bronchi and blood-vessels. The pulmonary artery and its branches are diminished in size, and the bronchial tubes are also thinned.

Microscopical characters.—The atrophic process commences at the vesicular septa, which project inwards to subdivide the infundibula or alveolar spaces of the lung into true air-cells or alveoli. The process is one of simple withering and obliteration of capillaries, dependent on diminished respiratory function and blood-volume. The septa dwindle down to mere ridges upon the infundibular walls; and these walls in their turn become thinned even to perforation and coalescence of several air-spaces. Thus, without any corresponding enlargement of lung, there is an apparent enlargement of air-cells from the simplification of structure. A certain degree of fatty degeneration, affecting especially the minute vessels and the nuclear remains of the pulmonary epithelium, is associated with this simple atrophy, as with all other atrophic processes.

When atrophy of the lung is associated with, or the result of, other diseases, as emphysema or forcible collapse, the process is essentially the same, but is combined in the former case with over-stretching of the air-cells, and more or less thickening of the fibrous tissues derived from the bronchial and perivascular sheaths, from repeated congestions. Thus we have a larger and heavier lung; and, in the later stages, more marked fatty degeneration of its fibrous texture.

In cases of atrophy from the long-continued pressure of fluid in the pleura, the pleura is always thickened from the original inflammation, and fibrous processes are directed inwards from it between the lobules, so as to render difficult any subsequent expansion of the lung.

In the case of atrophy from compression of the lung by fibrous growth or fluid effusion, we have again often a heavier lung from increase of fibrous tissue. It is obvious that the increase in weight must always be due to attendant, often determining, disease.

Effects and Symptoms.—The consequences of the partial atrophy of lung which accompanies the 'large-lunged' emphysema of advanced middle life are very grave. Extensive obliteration of the pulmonary capillaries, without a corresponding diminution in the blood-volume, induces a stress of circulation, a mechanical congestion, which ultimately tells back through the right heart upon the whole venous system. The damaged elasticity of the lung impairs the mechanism, as the atrophy of the alveoli impairs the function of respiration. In senile emphysema, however, the lung-atrophy, being but a part of a general atrophy of all the tissues and of the blood, causes no discomfort, provided no extra effort is attempted, and no bronchitis supervenes. Local atrophy of the lung has its symptoms merged in those of the predominant disease.

Physical Signs.—In senile atrophy of the lungs the chest-capacity is diminished in all directions to accommodate the small lungs. The lower ribs are approximated and their obliquity greatly increased; the upper intercostal spaces are depressed. The chest-movements are very limited. The percussion-resonance is generally increased over the chest, except over the præcordial region, which is less covered by lung than natural. The respiratory murmurs are simply enfeebled, not altered, unless there be some bronchitis present. It has been said that there may be some effusion into the pleura in atrophy of the lung, to fill up the space vacated by the shrunken organ. The mechanism of such an effusion is, however, quite inconceivable.

Complications.—There are no complications necessarily incident to senile atrophy of the lung. Bronchitis not uncommonly, however, supervenes, and proves fatal to the patient.

Treatment.—The treatment of senile atrophy of the lungs simply consists in shielding the aged person from the causes of bronchitis. R. Douglas Powell.

LUNGS, Brown Induration of.—The condition recognised under this name by Laennec and Virchow, is one which is sometimes observed after prolonged mechanical congestion of the lungs, particularly that which results from disease connected with the mitral orifice. The morbid change consists mainly in excessive pigmentation, the pigment accumulating not only in the interlobular tissue, but also in the alveoli and minute bronchi, where it is enclosed in enlarged epithelial and granular cells. At the same time the capillaries are dilated, the interstitial tissue is increased, and probably the alveolar walls are thickened. The pigment is granular, and of a yellowish colour; it is derived from the blood, and seems to be of the nature of hæmatoidin. It may become brownish, reddish, or even black; and ultimately may be found free. The extent and degree of brown induration vary much in different cases. When the change is marked, the lungs are enlarged, heavy, firm, incompressible, and inelastic, not collapsing on exposure. They present various tints, from yellowish- to reddish-brown. This alteration in colour is also evident on section, and red spots are often seen, shading into black, while a brownish fluid may be expressed. Brown induration is associated with congestion of other parts of the lungs, and often with infarctions. It cannot be clinically recognised apart from these conditions, unless the affected organs should present physical signs of more or less extensive chronic consolidation in cases of known pulmonary congestion from mitral disease. No special treatment is called for.

Frederick T. Roberts.

LUNGS, Cancer of.—*See* Lungs, Malignant Disease of.

LUNGS, Cirrhosis of.—A synonym for chronic pneumonia. *See* Lungs, Inflammation of: D. Chronic Pneumonia.

LUNGS, Collapse of.—Synon.: Apneumatosis; Fr. *Affaissement Pulmonaire*; Ger. *Lungencollapsus.*

Definition.—Simple diminution in size of the whole or of a part of a lung, with reduction of the volume of the contained air; caused by interference with its free entrance in inspiration.

Ætiology.—The causes of collapse of the lung are either *intrinsic* or *extrinsic*; and frequently the two classes of causes are combined. The *intrinsic* causes present actual obstruction of the respiratory passages, and include all diseases of the larynx, trachea, and bronchi attended with inspiratory dyspnœa, whether due to the pressure of external tumours, to affections of the passages themselves, or to the presence of inflammatory products, blood, or foreign bodies within them. To this class of causes belongs the collapse of the lung which is apt to follow infantile bronchitis, when the tubes become obstructed, and there is no power to expectorate. All causes that interfere with respiratory efficiency favour the occurrence of the condition named. A plug of mucus may be drawn, in inspiration, deeper and deeper into the bronchial tubes, which it obstructs, and, acting like a 'ball plug,' allows the expulsion of air in expiration, but interferes with inspiration; the air not being replaced, apneumatosis is developed; and as there is no air behind the plug of mucus, cough is powerless to expel it. In children, bronchial inflammation is exceedingly common; and, the smaller tubes being proportionately smaller in the child than in the adult, the danger of collapse is increased. When children under five years of age die of bronchitis and allied affections, apneumatosis is almost invariably present; and 25 per cent. of the total mortality of infants may be safely set down to this cause. Partial collapse of the lung from pressure on the respiratory passages will be found described in the article MEDIASTINUM, Diseases of. The *extrinsic* causes of pulmonary collapse are certain conditions of the walls of the chest, which diminish the force of the inspiratory act, such as paralysis or debility of the inspiratory muscles, and softness of their bony attachments. Muscular paralysis is seen in injuries to the cord. Debility of the respiratory muscles may often be observed before death. Collapse of the lung is sometimes, although rarely, met with in adult life, when great prostration occurs in the course of fever, and respiration is impeded by pulmonary congestion. Associated as it is with softness and weakness of the ribs, rickets is one of the most frequent causes of collapse of the lungs. The action of the inspiratory muscles may be still further interfered with by abdominal distension, or by the binding up of the abdomen of the infant with tight bandages. The danger of collapse is lessened when the ribs have gained firmness and fixity, and when, raised by the respiratory muscles, the thoracic cavity is enlarged, and the lungs are consequently expanded.

ANATOMICAL CHARACTERS.—The whole of one lung or of one lobe may be affected, but a lobule or a part only of the lung is usually involved, the affected lobules being abruptly separated from those adjoining. As a rule, several patches of collapse occur in each lung, having a darker colour and more depressed surface than the healthy parts. The lower margin of the left lower lobe is most frequently affected. The collapsed portions of lung are similar to the liver in consistence: they resist pressure, are non-crepitant, are smooth on section, and sink in water. The bronchi are filled with mucous fluid; there is an entire absence of air in the collapsed parts. On inflation, the affected portion assumes a natural appearance, unless considerable congestion exists; whereas in pneumonia inflation cannot restore the lung to its natural appearance. In pneumonia pleurisy is rarely absent; but in collapse, uncomplicated with diathetic disease, the pleura is invariably healthy.

SYMPTOMS.—The symptoms of collapse of the lung vary greatly with the cause, rapidity, and extent of the morbid condition. In severe cases, for example, in the collapse that follows bronchitis in very young subjects, the symptoms are peculiar. There is great prostration, debility, restlessness, and sleeplessness. The temperature falls; the surface becomes cold, blue, or dusky; the eyes become shrunken; and the pulse is quick and small. There is a constant feeble whining cry. Respiration is very quick and shallow, as high as 70 to 80 or even 100 per minute. The rhythm is changed, the interval being between inspiration and expiration, instead of after expiration. There is no pain as in pleurisy. The cough is constant and impotent; is often followed by a cry of impatience; and differs much from the suffocative cough of bronchitis.

On examining the chest, the lower part is found retracted and diminished in diameter. The intercostal spaces sink in inspiration, and move outwards slightly in expiration. When the collapse is extensive, the percussion is dull and resistant, unless the affected lobules are interspersed among the healthy ones. The respiratory murmur is lost over the affected parts; though conducted breath-sounds, of a bronchial character, and rhonchi are generally audible almost universally. In the simpler cases of collapse of the lungs, such as occur in pertussis during the severe fits of coughing, some of these symptoms and signs may be suddenly developed, and again speedily disappear.

DIAGNOSIS.—Apneumatosis may be distinguished from croupous pneumonia by the comparative rarity of the latter disease in infancy; and by absence of the great heat of skin, and of fine crepitation on auscultation. From extensive miliary tuberculosis it is diagnosed by the absence of advancing symptoms of constitutional disorder, though the two conditions may co-exist. In pleurisy, the dulness on percussion, and the absence of respiratory sounds at the base, are much more marked than in apneumatosis. Congenital collapse or *atelectasis*, is a condition which has to be distinguished from infantile collapse or *apneumatosis.* Readily separable by symptoms, these two conditions may be indistinguishable by physical signs. In atelectasis the lung retains, in whole or in part, its fœtal condition, nature having failed to establish respiration and fit the child for its new mode of existence. In apneumatosis the once permeable lungs cease to admit air, and thus death from apnœa occurs without any apparent structural change being discoverable, save that the respiratory organs bear the appearance of fœtal, unexpanded lungs.

Prognosis.—The prognosis in collapse of the lung is favourable if the affection is recent, and the child healthy, with fair muscular power, and under favourable hygienic conditions. On the contrary, the disease is generally fatal if it involve a considerable extent of lung, especially if it supervene on atelectasis. Death usually occurs from slow asphyxia, the effect being the same as if the size of the lung were reduced by the removal of the affected parts. As much as half of the entire lungs has been found involved, thus fully accounting for the quickened respiration, the distress, and the dyspnœa, and for the bloodlessness and extreme pallor, with cold, blue extremities. The fatality of whooping-cough in infants is mainly due to the ready collapse of the lungs, specially when the child is badly nourished and breathing impure air. The natural course of the disease is from bad to worse: more lung is involved each day; and death occurs after two or three weeks from slow asphyxia. If collapse follows acute bronchitis, death often ensues rapidly; but if recovery takes place, the lungs are slow to regain activity, and the seeds of future mischief may remain. After an attack of pneumonia, complete absence of breath-sounds may exist for a time, and then suddenly—after a blow, shock, or violent cough—air enters the collapsed portion of lung, and the respiratory sounds assume a normal character.

Treatment.—When this affection was looked upon as a form of pneumonia it was treated by depletion. Now that we realise that it is not of an inflammatory character, our object must be not to lower vitality but to diminish excessive secretion. Slight counter-irritation, by means of stimulating embrocations, is useful. An emetic of ipecacuanha will help to remove accumulation if the patient is not too weak. Expectoration may be promoted by small doses of the same drug. When the lungs are extensively involved, vital power must be kept up by the help of ammonia, steel, phosphate of iron, port-wine, and beef-tea; and the food must be selected so as to be digestible by the stomach of the infant.

E. Symes Thompson.

LUNGS, Compression of.—Synon.: Fr. *Compression du Poumon*; Ger. *Lungencompression.*

Definition.—Diminution in size of the whole or of a part of a lung, associated with reduction of the volume of the contained air; caused by pressure on the pleural surface.

Ætiology.—Compression of the lung may arise in the course of numerous diseases or injuries affecting the chest; the compressing influence being either gaseous, liquid, or solid.

First, the admission of *air* to the pleura from without, through a perforating wound, as from a sword or bayonet thrust; or from within, as by rupture of an air-cell, or the extension of pulmonary ulceration through the pleura,—produces in either case compression. If no previous pleurisy has existed, the compression is complete; but if, on the other hand, long-standing pleurisy has caused adhesion, compression cannot take place, or will be but partial.

Secondly, compression may arise from the presence of *fluid*, such as pleuritic effusion, acute or chronic; passive, non-inflammatory effusion, as in hydrothorax; or blood, as in hæmatothorax.

Thirdly, compression of the lung by *solids* is seen in the case of various tumours of the chest, whether originating in the mediastinal structures, in the lungs, or in the thoracic parietes.

In a fourth class of cases compression of the lung is the result of the enlargement of neighbouring parts, other than the thoracic viscera; and especially of the abdomen, as in ascites, and tumours of the liver, spleen, or ovaries.

Anatomical Characters.—Compression of the lung may be either general or local, complete or partial. A lung compressed by pleuritic effusion is found to be reduced in volume, non-crepitant, dense, but not quite insusceptible of inflation. The blood is coagulated in the affected lobes, the clot being often decolorised and adherent to the walls of the vessels, many of which are impervious, or altogether obliterated; while the pervious vessels and the air-cells of the adjacent parts are distended, and emphysema is produced. In other cases, the compressed lung proves to be anæmic, tough, and dry.

In cases of slow recovery from chronic empyema the lung is often found bound down and thickened. The thoracic cavity vacated by the shrunken lung is occupied by the displaced heart, and sometimes by the extension of the sound lung across the middle line.

Symptoms and Physical Signs.—The symptoms of compression of the lung vary greatly in accordance with its causes, the rapidity of onset, and the extent and degree of compression. If pleuritic effusion be very rapid, the dyspnœa may be exceedingly urgent. After perforation of the pleura with sudden collapse of the lung, there also occur acute pain, dry cough, and painful spasms of the intercostal muscles. The pulse is frequent, feeble, and often irregular. Symptoms, more or less acute, of inflammation may follow. In other instances the symptoms are those of hydrothorax, or of intrathoracic tumour.

The physical signs of compression of the lung are chiefly those of the associated cause, such as pneumothorax, pleurisy, hydrothorax, or intrathoracic tumour; and partly certain phenomena characteristic of the physical condition of the lung itself. The latter vary considerably with the degree and extent of compression, but they may be described in general terms as follows: Either increased clearness of the percussion-sound over the area of compressed lung, with tubular or rarely even tympanitic quality, especially in children, or in extreme cases of compression complete loss of resonance; indefinite, weak, but occasionally rather blowing or tubular respiratory sound, sometimes mixed with scanty, dry, subcrepitant rhonchus; and exaggerated loudness and ringing quality of vocal resonance. A further description of these symptoms and signs will be found under the headings of the various causes of compression referred to.

Diagnosis.—The diagnosis of compression of the lung is in general simply the diagnosis of the condition on which it depends.

Prognosis.—The prognosis depends on the cause of the compression. Thus in pneumothorax it is unfavourable, though recovery may take place. In hydrothorax the ultimate prognosis is unfavourable, as it is usually an evidence of formidable, if not incurable, organic disease. In pleurisy, if the effusion has been rapid, met by prompt treatment, and uncomplicated with hectic, complete recovery may take place without much compression of lung or distortion of chest; but incompletely cured pleurisy is too frequently the first incident in the history of phthisical disease. In empyema the prognosis is more favourable than in pneumothorax or hydrothorax.

Treatment.—Little need be said as to the treatment of lung-compression. It resolves itself into that of the primary or causative diseases. Bearing in mind the injury done to the lung by compression, efforts should be made to relieve the lung before it has been irremediably bound down. The early adoption of paracentesis thoracis is the most practical means of gaining this end in pleuritic effusion. Remedies calculated to remove effusion and thus relieve the lung should be given, remembering that the more speedy the relief given to the lung the more complete will be the cure. Suitable movements of the chest might be ordered subsequently, with the view of promoting expansion of its walls and of the lung. Nor must a mention of the value of elevated health-resorts, the Engadine for instance, be omitted as a means of promoting the expansion of a lung which has been compressed.

E. Symes Thompson.

LUNGS, Congestion of.—*See* Lungs, Hyperæmia of.

LUNGS, Consumption of. — *See* Phthisis.

LUNGS, Degenerations of.—Changes of a degenerative character in connexion with the lungs constitute an important element in some pulmonary diseases, or they may be the sole morbid condition present. They are of the following nature:—

1. *Albuminoid.*—This is only very occasionally noticed, in extreme cases of general albuminoid disease.

2. *Fibroid.*—Changes leading to a more or less fibroid condition of the pulmonary tissue are of common occurrence, but it is not always easy to determine whether they should be regarded as due to a chronic inflammatory process, or to degeneration, and pathologists differ in their views on this point. As a degeneration, the fibroid change may be considered as most important in connexion with emphysema, and it is regarded by some authorities as an element of much consequence in the causation of many cases of this disease. It also follows long-continued congestion, and collapse or compression of the lung from any cause. Of course much fibroid or fibrous tissue is found in the lungs in many cases of phthisis, and in connexion with pleuritic adhesions and other conditions, but this lesion must be looked upon mainly as of inflammatory origin. The effects of these changes are to make the lung-tissue firmer and tougher, but at the same time to diminish or destroy its elasticity, the elastic tissue being more or less displaced. Hence, if the lungs be exposed to any distending force, they cannot recover themselves properly, and the air-vesicles remain more or less permanently dilated.

3. *Fatty.*—This degeneration is also regarded by some pathologists as one of the main elements in originating many cases of emphysema of the lungs, and also as one of the essential changes in this disease. Here, again, the lung-tissue is impaired in its elasticity and resisting power to distension, but it is not tough. Granular fat may be visible under the microscope.

4. *Pigmentary.*—The lungs become the seat of more or less pigmentation with increasing age. They are also markedly affected in certain occupations in which carbonaceous or other materials are inhaled. In so-called brown induration of the lungs there is an abundance of pigment.

5. *Senile.*—The lung-tissue undergoes atrophy, with more or less loss of elasticity, owing to wasting of the elastic tissue with increasing age, and even a fatty degeneration may take place. Hence, in such subjects emphysema is readily set up by causes which would have no similar effect on younger persons.

6. *Secondary.*—Under this head may be included those degenerative changes which take place in morbid formations in the lungs, such as inflammatory deposits, tubercle, or cancer. These belong mainly to the fatty or caseous variety of degeneration, but calcification may also occur.

Frederick T. Roberts.

LUNGS, Embolism of.—*See* Lungs, Anæmia of; and Lungs, Hæmorrhage into.

LUNGS, Emphysema of.—Synon.: Fr. *Emphysème du Poumon*; Ger. *Lungenemphysem.*

Definition.—An excess of air in the lungs, whether due to a dilated condition of the air-sacs, or to the presence of air in the interlobular tissue.

Varieties.—There are two forms of emphysema of the lungs, namely: A. *Vesicular Emphysema.* B. *Interlobular Emphysema.*

A. Vesicular Emphysema.—Vesicular pulmonary emphysema exists in three forms, namely, (1) *partial lobular*; (2) *lobular*; and (3) *lobar.* The last form involves the whole of a lobe, or the whole of one or both lungs. The first form is rarely seen alone, but is generally associated with the second form, which is very common, and is found in connexion with diseases, such as bronchitis, which are attended with violent or long-standing cough. The third form is by far the most important, and will be more especially referred to in the present article. It more frequently attacks both lungs than one, and the lower as well as the upper lobes. It is a serious malady, and sometimes destroys life at an early period. Its features are characteristic: the lung-substance has a peculiar doughy feel; pits on pressure; is wanting in healthy crepitation; and has a colour very closely resembling that of a calf's lung. It has been described as 'large-lunged vesicular emphysema.'

Ætiology.—*Determining causes and mechanism.*—With reference to the determining causes of emphysema, there are two theories, namely, the inspiratory theory, and the expiratory theory. On the first view the dilatation and rupture of the air-sacs are accounted for by the over-distension of the lungs in inspiration. On the second view these changes are considered to be caused by the strain to which the lung-tissue is subjected in violent expiratory efforts, especially the act of coughing. It has been thought by others that emphysema must be looked upon as a complemental lesion, arising in consequence of the over-distension to which the healthy portions of the lungs are subjected in cases of pulmonary collapse. Without entering into any critical examination of the theories as to the mechanical causes of emphysema, it may perhaps be sufficient to say that there can be little, if any, doubt that the lobular forms of the disease are mainly produced by expiratory efforts, such as violent cough, or blowing wind instruments. They have their seat in those parts of the lungs which become most distended by such acts. With regard to the lobar form of the disease, however, this explanation of its mechanism does not suffice. In this affection the inspiratory power is that which distends the lungs. The pulmonary tissue has lost a portion of its elasticity, it yields to distension, and no longer reacts perfectly when the distending power ceases. Further distension follows; reaction diminishes still more; until at length in some instances the lungs become greatly enlarged.

In senile cases the loss of elasticity of the chest-walls aids in preventing the pulmonary reaction.

Anatomical Characters.—In the early stages of emphysema there is simply a dilatation of the air-sacs; an increase in the size of the alveoli; and a diminution in the height of the alveolar walls, which, yielding with the distending cavities, become partially obliterated. As the disease progresses, the air-sacs become more distended and the walls of the alveoli sometimes completely obliterated, so that the air-sacs are quite smooth, instead of honeycombed. Then follows perforation of the air-sacs—at first slight, here and there an oval opening being discoverable; afterwards the openings become larger and more numerous. The subsequent progress of the disease is attended with further distension of the air-sacs, and rupture of the fibres of their walls. The openings thus caused coalesce, until at length the walls are simply represented by membranous shreds, and even large vesicles may form. These changes, varying in degree, characterise all the forms of emphysema. In the lobar form, however, perforation takes place to a much greater extent, *quoad* the amount of dilatation, than in the lobular or partial lobular form.

The emphysematous lung is anæmic; and its blood-vessels become widely separated, and often ruptured and atrophied. The bronchial tubes are sometimes dilated, especially in old-standing cases, and in these there is frequently found an increased development of the circular muscular fibres.

There is a form of lobar emphysema which is met with in old age, and which differs in some respects from that already described. The lungs are not so large; they are universally distended, however, to a greater or less extent; and they present a somewhat atrophied appearance. The alterations, of which they are the seat, are probably the result of those changes which age produces in the chest-walls, impairing their elasticity. This loss of elasticity may also affect the lung-tissue. *See* LUNGS, Atrophy of.

SYMPTOMS.—A constant and generally gradually increasing dyspnœa is one of the most important and most frequent of the symptoms of emphysema. Cough, with expectoration, is generally more or less present. Hæmoptysis is rare, and, when it does occur, is slight. The patient usually complains of no pain, but of a feeling of oppression, or a 'smothering in the chest.' In severe cases of lobar emphysema this last symptom and the dyspnœa are often the only circumstances which attract the attention of the sufferer to his malady. In other instances, however, and especially when the disease is only partial, a close examination will elicit the fact that there have been bronchitic symptoms. Few cases of emphysema exist for any length of time without the occurrence of asthmatic seizures. In advanced cases the aspect is peculiar. The countenance is dusky, leaden, and puffy. The nostrils are dilated, and expand widely on inspiration, whilst the angles of the mouth are drawn down. The voice is feeble. The whole body has a cachectic appearance, and is sometimes much wasted. General dropsy often ensues.

A knowledge of the changes produced by emphysema affords an explanation of the peculiar character of the respiratory movements and sounds, as well as of the other physical signs and symptoms of the disease. The lungs being the seat of general expansion, the thorax is kept abnormally distended. Thus it can undergo but little enlargement at each inspiration. As there is no impediment to the passage of air to the air-sacs, inspiration is accomplished rapidly. Not so, however, with expiration. The lung-tissue has in great measure lost its elasticity, and reacts slowly after distension; and this results in laboured, slow, and ineffectual efforts to expel the air. Further, as the lungs are more or less riddled with perforations, their aërating surface is diminished, and this necessarily causes dyspnœa whenever any increased demand is made on the respiratory function. The quantity of blood circulating through the lungs, even from the earliest stages of the affection, is also diminished; and the destruction of the capillary vessels, which ensues when the disease is more developed, further decreases the vascularity of the pulmonary tissue. Hence its pale, anæmic appearance after death, a circumstance which serves to explain how rarely it is the seat of pneumonic inflammation.

PHYSICAL SIGNS.—Amongst the most important of the physical signs of emphysema are the following: The upper part of the chest and the clavicles are prominent; the neck seems shortened; the fossæ above the clavicles are deepened; there is increased curvature of the dorsal spine; and the sternum is arched. The gait is stooping; the ribs are prominent; and the intercostal spaces are depressed. There is indeed a general increase in the size of the chest, usually most marked at the upper part. These are the features of the disease when it is extensive. If partial, or confined to one lung or part of a lung, the prominence of the chest exists on one side only, and the other symptoms and signs are less marked. The movements of the chest in respiration are peculiar. The breathing is for the most part superior thoracic, but the chest is not much expanded on inspiration, for the lungs are already inordinately distended. The lower end of the sternum and the lower ribs are drawn in during inspiration. In some cases during inspiration there is marked protrusion of the abdomen. The respiration presents other features. The inspiration is short and quick, and is followed by a prolonged and often wheezing expiration. Coughing is performed feebly, and expectoration is attended with difficulty. Percussion and auscultation elicit important diagnostic marks of the disease. When it is general, there is increased, and in some instances almost tympanitic, resonance over the whole of the chest, most marked towards the apices of the lungs, and along their anterior borders; and in partial cases almost confined to these spots, or to one side. The præcordial region is generally resonant, owing to the distended lungs coming between the heart and the wall of the chest; and the cardiac impulse can often be felt beneath the lower end of the sternum. The respiratory murmur is faint, and characterised by peculiarities which a knowledge of the anatomical condition of the lungs and of the chest-walls enables us to explain. The inspiratory murmur is short, and is followed by a prolonged expiratory murmur. This latter is unlike the sound heard in any other affection, and is, in fact, pathognomonic of emphysema. In some advanced cases the respiratory sounds are scarcely audible, if the bronchial tubes are free from mucus, and no spasm exists. Laennec described a *râle* which he thought was peculiar to emphysema. He called it *râle crépitant sec à grosses bulles*. A *râle* such as Laennec described is often heard in emphysema, but it is not a dry *râle*. It is probably produced in the finest bronchial tubes, and is a modification of the sub-crepitant *râle* of bronchitis. Although valuable in aiding diagnosis when present, yet, from its frequent absence and the difficulty of distinguishing it from the ordinary sub-crepitant *râle*, it loses much of its diagnostic import.

Complications and Sequelæ.—Bronchitis is one of the most frequent of the diseases associated with emphysema of the lungs. It is rare for the latter affection to exist for any length of time without the supervention of the former. Bronchitis presents some peculiarities when it affects an emphysematous lung. It is rather the result of congestion than of inflammation. It often attacks the finer bronchial tubes; and, when severe, is attended with profuse secretion—a circumstance which, coupled with the fact that expectoration is less easily accomplished than when the lungs are healthy, seriously complicates the affection, and increases the danger of death from asphyxia. The inflammation sometimes runs on very rapidly, and copious purulent or puriform expectoration occurs. Even when this is the case, an examination of the tubes after death may reveal but little vascularity of the mucous membrane. These severe bronchitic attacks are very apt to be attended by the formation of fibrinous clots in the heart and the large vessels arising therefrom. Bronchitis, in a sub-acute or chronic form, is a very constant cause of winter cough in emphysematous patients.

Asthma, occurring with greater or less severity, is a frequent attendant on emphysema. The attacks come on for the most part during the night, and may possibly be due to the congestion of the lungs which takes place during sleep, or when the body is long in the recumbent posture. This congestion probably sets up an irritation, which gives rise to reflex spasm of the bronchial muscular fibres.

Secondary affections of the heart are constantly met with in advanced cases of emphysema. Many pathologists have believed that the right cavities alone become affected; but more recent observations have shown that the cardiac disease is not confined to one side. There is, in extensive emphysema, a general hypertrophy of the heart, with dilatation of all the cavities, especially of the ventricles. But hypertrophy is not the only change which takes place—valvular disease is frequently found. The deposits and thickening which occur about the valves are no doubt secondary to the changes in the muscular walls, and must be attributed to the general malnutrition produced by the disease. It is not difficult to understand how it happens that in emphysema there is general cardiac hypertrophy. The impediment which exists to the circulation of the blood through the lungs necessarily gives rise to an overloaded state of the right side of the heart; hence results increased action of the right cavities, and hypertrophy of their walls. Again, the overloaded state of the venous system, and the consequent impediment to the capillary and arterial circulation, call for increased action of the left ventricle; and this is followed by its dilatation and thickening. There exists also another cause, which probably has some influence in producing this cardiac hypertrophy, namely, the altered position of the heart. This organ is pushed downwards, and its impulse is often felt strongly in the epigastrium. The position of the ventricles is therefore changed, and the direction of the axis of their cavities is altered with reference to that of their great vessels. This must lead to embarrassment of the circulation.

As a consequence of the changes in the heart and venous system in emphysema, dropsy often results. Many cases go on for a long time without any dropsical symptoms, whilst in others there is only slight œdema of the legs. In advanced cases, however, there is frequently general dropsy complicated with albuminuria.

General emphysema is attended in its progress with symptoms of cachexia and anæmia. In some cases there is much wasting of the muscular system, even before dropsical effusions occur. Further, the patients often have a sallow and anæmic appearance, not unlike that met with in renal and other serious organic diseases. There has been an impression that emphysema and phthisis are incompatible diseases, but recent researches have shown that this view is not correct. Indeed, in most cases of death from phthisis, patches of emphysema, involving the whole or part of a lobule, are met with; and doubtless have been produced by the fits of coughing so common in the disease. But the great question is whether tubercular deposit ever takes place in lungs which are the seat of lobar emphysema; and this question must be answered in the affirmative, although the concurrence of the two diseases is uncommon. Pneumonic consolidation is very rare in an emphysematous lung.

Pleurisy not infrequently exists in connexion with emphysema; pleuritic adhesions being often found after death. The occurrence of pleurisy must, however, be considered as an accidental circumstance. In the most extensive cases of emphysema pleuritic adhesions may not be found.

Pathology.—The pathology of emphysema involves some important points for consideration. The great question is whether there is any degeneration of tissue preceding or attending the affection. When the disease is partial, and has followed or is attended by bronchitis, or some other affection in which there has been violent or long-standing cough, the emphysema may be the result of mechanical violence, without pre-existing degeneration of the lung-tissue. When, however, it is of the lobar form, degeneration is probably the primary step in the affection. The facts which tend to confirm this view are: (1) the insidious manner in which the disease sometimes comes on, and the development which it attains, without any previous history of violent or long-standing cough; (2) the frequency with which it attacks the whole of both lungs; and (3) its hereditary character. The exact nature of the degeneration has not been satisfactorily made out. Fatty matter has been found in a few instances, but not in all cases. The degeneration is probably one primarily involving the elastic fibres and other structures of the walls of the air-sacs. Whatever be the nature of the degeneration, there can be no doubt that lobar emphysema is a malady resulting from some form of malnutrition of the lung-tissue. There is reason to believe, too, that this form of emphysema is sometimes associated with gout.

Treatment.—This must be referred to under two heads, namely (1) the treatment of *the disease*; and (2) that of *the secondary affections*, which follow or are associated with it.

1. *Treatment of the disease.*—Too little attention has been paid to emphysema of the lungs as a substantive disease. Considered in the main as the result of bronchitic affections, the treatment has been chiefly directed to the control of these attacks; and in regard to the partial forms of emphysema, this is a most important object. But in reference to lobar emphysema, if we recognise the fact that it is primarily due to some degeneration of tissue, it is obvious that the treatment should be directed to check, if possible, this process. It can scarcely be expected that, when once perforation and rupture of the air-sacs have taken place, the normal condition of the lung can be restored. But, whilst we admit this, it is by no means implied that the disease is beyond control. That condition of lung-tissue which precedes the perforations—the simple distension of the air-sacs—admits of great amelioration, and further degenerative changes may be, if not prevented, at least much retarded.

The main principles of treatment should be such as guide us in the management of other constitutional diseases attended with degeneration. All measures which tend to invigorate the system, to give tone to the heart, and to improve the condition of the blood, should be resorted to. Amongst the remedies for internal administration the most useful is iron. It should be given in small and continued doses. Quinine is valuable, as are also the various bitters and other remedies for dyspepsia, from which emphysematous patients often suffer. Cod-liver oil is very useful in some cases. Strychnine has been recommended with the view of improving the tone of the muscular fibres of the bronchial tubes. It has not been found useful in this respect; nor need we wonder at this, for the disease is one primarily of the air-sacs, and not of the bronchial tubes, and, if the muscles of the latter are secondarily affected, it is rather with spasm than paralysis. Small doses of strychnine given for dyspeptic symptoms may be useful. In some cases iodide of potassium has apparently been beneficial. Probably these cases have been associated with gout.

Breathing compressed air has been strongly advocated, and no doubt it has afforded in some cases decided temporary relief, and good effects are said to have followed its use. *See* Air, Therapeutics of.

The regulation of the diet, and the general management, are most important. The diet should be nourishing, and a moderate amount of stimulants should be allowed. The food should be easy of digestion, and nutritious in proportion to its bulk. The stomach should never be overloaded, as that condition will give rise to dyspnœa. Errors of diet must be avoided, and the functions of the bowels should be carefully regulated. Another point is to give the lungs as little work as possible, and to let the patient breathe a pure air. All violent exercise, or physical exertion of any kind, must be strictly prohibited; moderate exercise is, however, to be recommended. Moderate walking, yachting, carriage exercise, riding at a quiet pace and on an easy horse, are important adjuvants in the general treatment of emphysema. The condition of the skin should be carefully looked to: warm clothing should be constantly worn; and the greatest care should be taken to ward off bronchial inflammation. Residence during the winter in a warm and dry climate is to be recommended.

2. *Treatment of secondary affections.*—Amongst the most important of the affections secondary to emphysema is bronchitis. No depressing measures should be used in this disease, but such as will promote expectoration, and check the secretion of the bronchial tubes, if, as is very frequently the case, this be excessive. Ammonia, the various stimulating expectorants, and iron are the most valuable remedies, together with moderate counter-irritation (*see* Bronchi, Diseases of). The dyspnœa attendant on emphysema admits only of palliative treatment, but is often greatly improved by the observance of the rules laid down for the general management of the disease. The dyspnœa is always increased by the presence of bronchitis; by the stomach or bowels being overloaded; and by the general over-distension of the venous system, which necessarily ensues as a consequence of the impediment to the flow of blood through the lungs. Care should be taken to prevent any flatulent distension of the stomach or intestines, and to keep up a good action of the bowels, liver, and kidneys. For the relief of the asthma which frequently exists in connexion with emphysema, full doses of iodide of potassium are often useful. Stramonium may also be smoked, and other measures beneficial in ordinary spasmodic asthma may be tried (*see* Asthma). In refer-

ence to the treatment of the dropsical symptoms, which follow as a secondary consequence of emphysema, the reader is referred to the articles Dropsy; and Heart, Dilatation of.

B. Interlobular Emphysema.—This condition, in which the excess of air in the lungs is contained, not in the air-sacs and alveoli, but in the connective tissue between the lobules, is described under the head of Emphysema, Subcutaneous, to which article the reader is referred.

A. T. H. Waters.

LUNGS, Gangrene of.—Synon.: Fr. *Gangrène du Poumon*; Ger. *Lungenbrand.*

Definition.—Death of a portion of the substance of the lungs.

Gangrene of the lungs is of two kinds, namely, (1) *diffused*, in which the whole of one lobe or lung is affected; and (2) *circumscribed*, in which a portion only of a lobe undergoes gangrenous change.

Ætiology.—Gangrene is sometimes a result of acute pneumonia. It has been known to follow the inhalation of noxious gases. When it occurs independently of these causes it is an evidence either of extreme constitutional depression, or of pressure interfering with the circulation and nutrition of the lung. An aneurysm or mediastinal growth, pressing upon the main arterial, venous, and nervous trunks at the root of the lung, is perhaps the most common cause of diffused gangrene; whereas the more circumscribed form of the disease is a sequela of acute and limited pneumonia, cancer, bronchiectasis, or rapid phthisis in a debilitated subject. In pulmonary apoplexy gangrenous change sometimes occurs, the gangrene being limited to the portion of lung involved in the originating extravasation of blood. Pneumonia caused by a foreign body in the air-passages is apt to run on to gangrene. The diffused gangrene that occurs in drunkards and lunatics, in asthenic fever, measles, small-pox, and typhus, evidences excessive nerve-prostration and loss of nutritive power. In children, gangrene of lung sometimes follows cancrum oris, as well as the eruptive fevers.

Anatomical Characters.—The colour of a gangrenous lung is dark, dirty olive, or greenish-brown. It is moist or even wet; and either of the consistence of engorged lung, or softer and more diffluent. The odour is that of external gangrene or decomposed flesh, and is distinctive during life, rendering the room in which the patient lies horribly offensive. When scattered patches of gangrene occur, there is often in one part a solid mass of greenish lung-tissue, and in another a central sloughy or gangrenous cavity, surrounded by a broad rim of soft infiltrated lung. The seat of circumscribed gangrene is usually the periphery of the lung, and the lower lobes. If a bronchus open into the gangrenous patch, inflammation of the bronchial membrane is set up. In rare cases the pleura is involved, and pyo-pneumothorax is induced. Sometimes the pulmonary arteries are found plugged, and more often the bronchial arteries. In those rare cases in which recovery takes place, interstitial pneumonia is set up, leading to encapsulation of the gangrenous spot; the sloughs are ejected; and cicatrisation follows, as in pulmonary abscess.

In diffuse gangrene the whole of one lung is sometimes involved. The pulmonary tissue is then converted into a black, putrid substance, saturated with blackish purulent fluid; or the gangrenous part merges gradually into œdematous or hepatised tissue.

Embolism, arising from the introduction of putrid matter into the veins, and leading to abscess in various organs, may follow either form of gangrene. Secondary gangrenous change is frequently met with in other parts of the same or in the opposite lung.

Symptoms.—It is seldom possible to diagnose gangrene of the lung until the purulent discharge reaches a bronchus and is ejected. Then the sputa are found to separate speedily into layers—a superficial froth, a liquid middle layer, and a lower sediment. The smell of the sputa and breath is pathognomonic. The dyspnœa and prostration are usually great. The physical signs are those of softening and excavation, percussion being either dull or tympanitic, and loose crepitation being soon replaced by gurgling and perhaps amphoric breathing. The passage of the circumscribed into the diffused form may be traced by watching the physical signs.

Diagnosis.—Suppurative ulceration of the bronchial cartilages gives rise to great fœtor of breath. Sometimes a gangrenous odour in the breath occurs when the putrefactive change is limited to the secretions; and it may be present also in pyo-pneumothorax with internal fistula. These several diseases must be excluded by a careful estimation of the history and the physical signs. *See* Breath, The.

Prognosis.—The prognosis of pulmonary gangrene is hopeless in the diffused form; and it should be given very cautiously, even when the symptoms or signs point to a limitation of the mischief.

Treatment.—Every attempt must be made to support the strength by nourishing food and stimulants; bark and ammonia, quinine and acids, iron and cod-liver oil being indicated. The inhalation of creasote or carbolic acid in spray may be tried, or of turpentine given off from hot water.

When a gangrenous abscess of the lung exists, and it is evident that the passage of fœtid matters through the bronchi is setting up dangerous irritation, leading to exhausting discharge, or threatening to poison the system, the question of tapping the gangrenous cavity should be entertained. The introduction of a drainage-tube sometimes affords immediate relief in such cases. The fœtor of breath ceases; the offensive secretions, being no longer locked up in the lung, lose their putrescent character; and the relief to the constitution is great. An accurate diagnosis is in such cases essential, the danger of the operation being greatly enhanced if the abscess is at a distance from the chest-wall, and if the lung is not adherent to the costal pleura. The operation should only be performed when there is but little prospect of recovery without it, but must not be delayed until the vital powers are too reduced to allow of ultimate convalescence.

Besides the general treatment which coexisting disease may require, special attention must be given to the removal of the gangrenous odour from the atmosphere of the room, from the sputa, and from the patient, who is apt to exhale from the skin a similar odour to that given off in the breath. Sulphurous acid, carbolic acid, or chloride of lime fulfils the first indication; Condy's fluid the second; and this may also, when diluted, form a useful wash or gargle. The sulpho-carbolates, when administered freely, have a distinct value in removing the fœtor from the skin, and making the patient less unapproachable.

E. Symes Thompson.

LUNGS, Hæmorrhage into.—Synon.: Extravasation of Blood into the Lungs; Pulmonary Apoplexy; Fr. *Hémorrhagie du Poumon*; Ger. *Lungenblutung*.

Ætiology and Pathology.—In the article Hæmoptysis will be found enumerated the causes which lead to pulmonary hæmorrhage. In the present article only those extravasations of blood into the lungs are included which do not depend upon direct injury to the organ, or upon exposure and rupture of vessels in the course of destructive disease affecting it.

Hæmorrhage into the substance of the lungs may be *diffuse*, *punctiform*, or *circumscribed*.

(1) *Diffuse pulmonary apoplexy.*—The diffuse extravasation of blood into the lungs is an extremely rare condition. Some cases have been recorded, however, in which it has arisen from primary disease of a branch of the pulmonary artery. The lung-tissue is broken down by the hæmorrhage into it; and the patient soon succumbs.

(2) *Punctiform hæmorrhage*, and (3) *circumscribed* or *nodular pulmonary apoplexy*, are not of uncommon occurrence, and are attendant upon the same morbid conditions of the lung. Mitral disease—mitral stenosis especially, but also mitral regurgitation—is the chief remote cause of these two forms of pulmonary apoplexy.

In certain purpuric states of system, which we need not here specify, punctiform hæmorrhage in the lungs is possible; the purpura much more frequently affects, however, the pleural surface or bronchial mucous membrane. Mechanical congestion of the lungs, from the above-mentioned forms of heart-disease, is by far the most common condition upon which this minute and interstitial form of hæmorrhage supervenes, giving rise to no additional symptoms, but causing considerable and peculiar pigmentation of the lung. The interstitially thickened lungs acquire a brownish tint, from the absorption of the blood-spots, leaving hæmatin behind; and the appearance has given rise to the term *brown induration* of the lungs. *See* Lungs, Brown Induration of.

Nodular or circumscribed pulmonary apoplexy is often associated with the petechial hæmorrhage just described, and, like it, mostly supervenes upon the mechanical congestion of the lungs arising from heart-disease. There are two ways in which this form of hæmorrhage may be produced. The first way is by rupture of capillaries or small veins under the heightened pressure of the pulmonary circulation. An effusion of blood thus occurs, which fills up one or more lobules, and coagulates to form the dark firm consolidations so characteristic of the lesion. Or a branch of the pulmonary artery becomes obstructed by an embolus, for instance, by a fragment of coagulum conveyed from the right auricle, or from one of the systemic veins (phlebitis, varicose veins); and its territory becomes at once filled with blood, in the following manner. The pulmonary arterial vessels do not communicate with one another, each branching separately to its capillary distribution; the pulmonary veins, on the contrary, inosculate freely, and, moreover, are not provided with valves. Thus, when the onflow of blood is arrested through the obstructed arterial branch, venous regurgitation through the capillaries from collateral pressure fills up the precluded vascular area with stagnating blood, and the intra-alveolar tissues become speedily occupied with its effused corpuscles. In some cases the vessel may not at first be accurately closed by the embolus; the onward current is then retarded instead of being quite arrested; the mechanism is, however, practically the same.

Anatomical Characters.—A lung that is the seat of this form of hæmorrhage is usually toughened and heavy. Some hard, and more or less square, flat surfaces may be felt and seen raised above the general surface of the lung, which has shrunk below their level. The pleura covering such patches is darkened in colour, and presents flakes or granulations of lymph, impairing its translucency and smoothness. On making a vertical section through one of the surfaces, it is found to form the base of a more or less conical mass, which has a firm damson-cheese-like section, and is sharply defined from the surrounding tissue. In its axis is seen a branch of the pulmonary artery, occupied by partially altered clot. There is usually some staining of the pulmonary tissue immediately surrounding the apoplectic nodule, from imbibition. Such hæmorrhagic nodules vary greatly in number and size; there are usually several in each lung, of about the size of a walnut; but one may occupy a whole lobe. They also vary in appearance according to the date of their occurrence; their colour, at first that of dark blood-clot, passes through pale chocolate or catechu tint to yellowish-red or pale yellow, as the colouring matter becomes gradually absorbed. The whole extravasation may be gradually and completely absorbed, leaving the restored lung but little damaged; or a shrunken fibrinous deposition or blood-cyst, with surrounding induration, more rarely a calcareous centre, may mark the site of former hæmorrhage. It should be added that these extravasations, although generally near the pleural surface of the lung, are not always so, but may occur deeply in its substance; they occur more frequently in the right lung, and generally in the upper lobe.

Symptoms.—Amidst the distressing symptoms which are attendant upon the conditions leading to pulmonary apoplexy, it would be difficult to single out any diagnostic of this special lesion. An exacerbation of dyspnœa already terrible enough, or a sudden failure of pulse, may perhaps be noted. Dark scanty hæmoptysis is, however, the pathognomonic sign, the frothy mucous expectoration containing some streaks, or small clots, of dark coagulated blood. Some circumscribed patches of dulness, with bronchial breathing and neighbouring crepitation, may perhaps be made out, especially in the mammary and mid-axillary regions.

Prognosis and Treatment.—These lesions are among those which often close the scene in the heart-disease to which they are accessory; and are therefore irremediable. Sometimes when, from any cause, their occurrence appears to have been hurried forward; when the lividity is great, the dyspnœa urgent, and yet the disease is not of long duration; wet-cupping or bleeding from the arm will certainly give great temporary relief, and perhaps avert immediate danger.

R. Douglas Powell.

LUNGS, Hydatids of.

—Synon.: Fr. *Kystes Hydatiques du Poumon*; Ger. *Lungenechinococcus.*

Definition.—A disease due to the presence of hydatids in the lungs.

Ætiology.—Hydatid cysts in the lungs rarely occur in this country as a primary disease of these organs, but they are not infrequently met with as an extension of disease from the liver.

The general causes of hydatid disease are elsewhere discussed, but the circumstances which determine the localisation of the hydatid are not clearly ascertained. In Australia, where the affection is very common, it is met with sometimes in the lung without any other organs being affected; although, in many cases in which the lungs are diseased, evidence of the existence of the same disorder elsewhere is not wanting. Of 100 cases, the liver was the organ affected in 70, the lung in 12. The great prevalence of the disease in Melbourne is said to be due to drinking from water-holes frequented by sheep, and from eating watercress or uncooked salads containing the ova of the parasite.

Anatomical Characters.—The general anatomy of hydatid disease will be found in the article describing this parasite (*see* Entozoa). Single sacs of acephalocysts are by far most usual, varying in size from a pigeon's egg to a man's fist. Sometimes the upper and sometimes the lower lobes are the seat of the cysts. They are developed in the interstitial pulmonary tissue; as growth proceeds, the neighbouring parenchyma is converted into fibro-cellular tissue, and undergoes obsolescence. The parent sac, containing the echinococci, is adherent to the surrounding tissue.

If the parent sac be destroyed by inflammation and consequent suppuration, a communication is established between the cavity and the bronchi, through which the daughter-cysts may be ejected; just as in more common instances they may escape from the liver after perforating the diaphragm and lung. Not infrequently the pulmonary sac communicates with a similar sac in the liver. It is natural to infer in such cases that the disease originated in the liver. Indeed, it has been stated that primary hydatid of the lung is unknown.

Symptoms and Physical Signs.—Hydatids may exist in the lung for a considerable time without giving rise to any noticeable symptoms; but as the tumour enlarges and presses upon the surrounding tissues, hæmoptysis occurs, as also bronchitis, pneumonia, or even gangrene. Sometimes the cysts perforate the pleura and cause pneumothorax, or make their way through the diaphragm into the abdominal cavity. The more usual course is the converse of this, namely, that a hydatid of the liver exists perhaps for years; causes abdominal distension; and eventually discharges its contents through the diaphragm into a bronchus; then expectoration of blood occurs, with gooseberry-like 'skins,' varying in size from a nut (in which case the cyst may be expelled whole) to an orange (in which case the sacs are shrivelled and empty), and causing suffocating cough during expulsion.

If the site of the tumour be superficial, altered breath-sounds and percussion-note may be observed; but if it be deeply seated, the physical signs may escape detection. If bronchitis or pneumonia be set up, the signs and symptoms of these disorders mask those of the originating disease. Often the symptoms are like those of rapid phthisis, namely, cough, muco-purulent expectoration, hæmoptysis, night-sweats, and emaciation. The meaning of these symptoms is apparently confirmed by the physical signs, namely, dulness on percussion; absence of breath-sounds, or prolonged expiratory murmur; and, when the cysts burst, gurgling and pectoriloquy. Unless the daughter-cysts or hooklets are expectorated, there is nothing to point unmistakably to the nature of the disease. When perforation of the diaphragm occurs, hepatic symptoms or those of pleurisy supervene. The patient looks anxious; the features are collapsed; the skin is clammy and livid; the extremities are cold; incessant paroxysmal cough occurs, with vomiting; and by degrees sallowness and jaundice make their appearance. Symptoms of acute pneumonia may occur—of consolidation, followed by excavation; the expectoration being at first rusty, then bile-tinged, muco-purulent, and fœtid, and containing, besides shreds of lung-tissue, entire cysts or portions of them.

Diagnosis.—It may be difficult to distinguish a large hydatid cyst from pleuritic effusion, as the lung may be displaced, the chest bulges, and the intercostal spaces become prominent and fluctuating. The rounded outline of the dull space, the absence of acute symptoms, the history of gradual onset, the absence of ægophony and of alteration of physical signs on change of posture, will guide the decision; and an exploratory puncture, which gives exit to a clear, saline, non-albuminous fluid, containing possibly hooklets or fragments of cysts, will confirm the diagnosis. The conduction of the heart-sounds and impulse, and the tense unyielding condition of the bulged side on palpation, may lead to the suspicion of mediastinal tumour; but in the case of hydatids there is seldom any visible venous engorgement, or laryngeal or œsophageal pressure-sign, as in aneurysmal or other mediastinal growths. There is, moreover, generally a freedom from cachexia or constitutional disturbance. In circumscribed abscess the neighbouring lung is rarely so free from disease as in hydatid.

Prognosis.—Although the symptoms may be so severe as to threaten immediate death from suffocation, recovery occurs in at least half the cases in which hydatid disease begins in the lung, and one-third of those in which it spreads from the liver. If the cyst is allowed to burst of itself, recovery takes place in from 30 to 40 per cent. of cases. But the mortality is greatly reduced by early tapping.

Treatment.—Palliative treatment must be directed mainly to the mitigation of pain and other urgent symptoms. Curative treatment consists in destroying the vitality of the cyst. If the fluid contents are drawn off, or allowed to escape, the death of the hydatid may occur, or inflammatory action may be set up, leading to suppuration. If the fluid re-collect and pressure-signs recur, iodine or other stimulating fluid may be injected. The iodide and bromide of potassium, with kamala, have gained among Australian physicians reputation in these cases, especially when combined with the use of the trochar.

E. Symes Thompson.

LUNGS, Hyperæmia of.—Synon.: Congestion of the Lungs; Fr. *Hyperémie du Poumon*; Ger. *Lungenhyperämie.*

Definition.—Excess of blood in the lungs, whether local or general.

Varieties.—Pulmonary hyperæmia may be *active*, *passive*, or *obstructive.*

The morbid appearances and symptoms are different in these three kinds of hyperæmia, and they may, therefore, be best considered separately.

A. Active Hyperæmia of the Lungs.

Synon.: Active Congestion; Active Affluxion.

Definition.—A determination of blood to the lungs.

Anatomical Characters.—Active hyperæmia, or congestion, may affect any portion of the lung, which remains crepitant and little changed, save that it is more crimson in colour, and contains slightly more blood than natural. The condition is indeed rather a vital or physiological one; and, as in active hyperæmia of the skin, may present no *post-mortem* appearances. On section, however, the lung usually exudes some frothy serum, tinged with blood; and sometimes, especially when the hyperæmia is local and arises from collateral stress of circulation, there is found hæmorrhage into the lung. The mucous membrane of the bronchial tubes is minutely injected, or it may be quite natural in appearance.

Ætiology.—The causes which produce inflammation of the lung will also produce active hyperæmia, namely, cold, irritation, adjacent inflammation, &c. Increased action of the heart during violent effort or excitement, whether from mental emotion or from drink, will produce the same effect. It is said that the pressure of blood in the pulmonary artery increases more rapidly than that in the aorta during exertion (Colin). Hæmoptysis from pulmonary hyperæmia is commonly produced by the excessive imbibition of stimulants. Predisposition, either hereditary or in consequence of present disease, renders these last-named causes much more readily operative. Obstruction to the passage of blood through one portion of the pulmonary system of vessels, for example, by embolism, or by destruction of capillaries, will cause increased collateral activity of circulation. Sudden suppression of menstruation may cause active determination of blood to the lungs. Sudden diminution of the atmospheric pressure within the chest, as during violent inspiratory efforts, whilst the trachea is closed, for instance, in croup, laryngismus, or whooping-cough, may cause active determination of blood to the lungs.

Effects.—Several important effects may be produced by active hyperæmia of the lungs. Hæmorrhage is rarely extensive, unless there be attendant organic lesion present. Active hyperæmia of the lung constitutes the first stage of exudative or croupous pneumonia, with fibrinous exudation into the air-cells. Pulmonary œdema may result from the excessive blood-pressure, the serum exuded being frothy and blood-tinged. Vesicular catarrh is not so distinctly a consequence of hyperæmia, with which, however, it is often associated.

Symptoms.—The symptoms of active pulmonary hyperæmia are dyspnœa; more or less pyrexia; cough; and sometimes copious hæmoptysis, in which case precedent organic disease must be suspected. The rusty sputa of the first stage of pneumonia is that most typical of pulmonary hyperæmia.

Diagnosis.—The diagnosis would rest mainly upon the suddenness of attack, and the evidence of a sufficient determining cause, with or without predisposition.

Prognosis.—Active hyperæmia, save in some cases of collateral afflux, is necessarily a transient affection, subsiding in a few hours, or passing on to inflammation.

Treatment.—The first point in the treatment of this condition is to secure absolute rest in bed, with silence, and removal of all causes of excitement. Derivatives; mustard or linseed poultices to the chest; perhaps cupping, or even blood-letting; warmth to the extremities; saline purgatives; and a low diet, without stimulants, may all be employed. The special cause of the hyperæmia should be treated. As a rule, astringent medicines should be avoided. Digitalis is useful to calm the circulation, especially after excitement from alcohol. If the pyrexia be very marked, pneumonia may be expected, and saline diaphoretics are especially indicated.

B. Passive Hyperæmia of the Lungs.

Synon.: Passive or Hypostatic Congestion.

Definition.—An incomplete stagnation of blood in the lungs.

Ætiology.—Passive or hypostatic congestion of the lung is a condition of hyperæmia affecting by preference the most dependent parts of the lung. Failure of heart-power, an inability to propel the blood clear through the pulmonary capillaries, is the chief cause of this condition. In states of exhaustion from low fevers, especially typhus and typhoid; after severe surgical operations; in extreme old age; or towards the end of prostrating illness, this failure of heart-power, and consequent stagnation of blood in the lower parts of the lung, usually the bases, is apt to supervene, and is one of the common modes of death. An altered condition of the blood, so as to render its passage through the capillaries more difficult, is also stated to be a cause of this form of congestion of the lungs and of other organs. In uræmic and icteric conditions, and in the febrile state, the blood does not pass through the capillaries with the same facility as in health, and hypostatic congestions are more apt to occur. Finally, when the vessels have lost their tone, and the heart fails in power, gravitation exercises its influence in attracting the blood to the most dependent parts.

Anatomical Characters.—Passive hyperæmia almost always affects the bases of both lungs, although often not in an equal degree, the difference depending mainly upon the position of the patient during the last days of life. The affected lung is dark-coloured, and engorged with dark blood. Its tissue is more or less deeply stained with blood, and is less crepitant than natural, yielding also more readily than natural under the pressure of the finger. If thoroughly washed, however, in a gentle stream of water, the lung-texture will be found to be but little altered. This condition very readily passes into a low form of pneumonia, and thus portions of the lung may be found consolidated, having much the appearance and consistence on section of a congested spleen (splenification, hypostatic pneumonia). The bronchial tubes and pleura are affected by *post-mortem* staining.

Symptoms.—The symptoms of this form of congestion of the lungs are lividity, especially of the lips and extremities; and quickened shallow breathing; superadded to those of extreme prostration. Dulness on percussion, with enfeebled breathing and moist crepitant *râle*, are found over the bases of both lungs, but in greatest extent on that side to which the patient has been inclining.

Treatment.—Passive hyperæmia of the lungs being never the primary affection, and always being a sign of failing power, its treatment consists in vigorously supporting the patient by alcoholic stimulants frequently administered, and with nutritious food. Nutritive enemata are often of great value. In all exhausting diseases this condition should be anticipated, and warded off if possible by timely support and stimulants, and above all by frequently turning the patient from one side to the other, thus calling in the aid, rather than permitting the hindrance, of gravitation to the circulation through the lungs. Of medicines, ammonia, ether, bark, and quinine are of the greatest value; and musk, sumbul, and lavender may be useful adjuncts.

C. Obstructive Hyperæmia of the Lungs.—Synon.: Mechanical Congestion.

Definition.—Hyperæmia from obstruction to the escape of blood from the lungs. Mechanical congestion of the lungs is a condition differing essentially from either of the two preceding.

Ætiology.—The origin of this form of hyperæmia is purely secondary and mechanical, and is included in that of the primary disease. The obstruction may be at the mitral valve, as in mitral stenosis or regurgitation; or, again, the obstruction may be at the left ventricle, when this cavity is dilated and imperfectly emptied, as in the advanced stages of constrictive or regurgitant aortic disease. Whether there be an absolute narrowing of the blood-channel between the pulmonary and systemic circulations—that is, at the mitral orifice or at the commencement of the aorta; or whether, from enlargement of the mitral orifice or from disease or injury of its valve, regurgitation be permitted, so that each contraction of the right ventricle is met and opposed, more or less, by a counter rush of blood from the left ventricle—in any case, and still more in the combination of two or more of these causes, it is clear that the pulmonary circulation can only go on at an increased pressure by the contraction of the right ventricle becoming more vigorous; and that hyperæmia must result from the damming back of the blood through the pulmonary veins.

Of the causes named, mitral constriction is that which leads most simply to obstructive hyperæmia of the lungs.

Anatomical Characters.—It is obvious that obstructive hyperæmia is of general distribution, affecting the whole of both lungs. The result of the heightened blood-pressure from increased force of injection into the lungs, to overcome an impediment to the escape of blood from them, is most felt in the pulmonary capillaries. These capillaries gradually become lengthened, tortuous, and dilated even to three times their normal dimensions (Rindfleisch). From chronic engorgement of the lungs, the nuclei of the interlobular areolar tissue and of the connective tissue surrounding the minute vessels and bronchi, and pervading the parenchyma, proliferate. The thickened and tortuous capillaries intrude upon the air-spaces; and, the elasticity of the lungs being also impaired, their vital capacity is diminished. It is stated that the muscular fibres, which proceed from the bronchial terminations to form loops upon and encircle the infundibula, become hypertrophied (Rindfleisch), thus, perhaps, compensating for a diminution in the more mechanical elastic property of the lung. Sometimes minute hæmorrhages take place into the parenchyma of the lung; sometimes larger escapes of blood fill the alveoli of circumscribed patches (pulmonary apoplexy). The total result of the intimate changes described is an uniform increase in the size and weight of the lungs, with an increased density and toughness. On section, the lungs are found to be more pigmented and solid-looking than natural, sometimes of a brownish hue (brown induration); they are, however, crepitant throughout, except here and there, where they may present the firm, dark, damson-cheese-like section, fading to brown-red, of recent pulmonary apoplexy. There may be some œdema present. The pulmonary arteries and veins are enlarged and congested; and the bronchial mucous membrane is usually the seat of chronic catarrh. Patches of atheroma are frequently to be seen in the larger branches of the pulmonary artery.

Symptoms.—Dyspnœa and cough, both brought on or increased by effort, with palpitation, and oppression or tightness, usually referred to the epigastrium, are the most constant symptoms of obstructive hyperæmia of the lungs. Patients suffering from this condition have repeated attacks of bronchial catarrh, and hæmoptysis is of common occurrence. The hæmoptysis may be considerable, but more usually the expectoration is streaked with blood or contains small dark coagula.

This form of hyperæmia commonly occurs before middle life, during the usual period of mitral heart-disease. The signs of heart-disease, and most often of constriction of the mitral valve, are present. The subjects of this affection are often undersized and badly nourished; the pigeon-breasted type of chest being common, especially in those cases in which the disease manifests itself early in life. Small, frequent pulse; more or less lividity of lips; and other signs and symptoms of the cardiac disease, of which the pulmonary condition is the consequence, are to be observed. A fine inspiratory crepitant *râle* over the lungs may be heard. During the repeated bronchial catarrhs, with increased pulmonary hyperæmia, to which such patients are especially prone, all symptoms are much aggravated.

Diagnosis.—The existence of obstructive heart-disease suggests the presence of corresponding hyperæmia of the lungs. The fine crepitant *râle* and the hæmorrhagic symptoms and signs more positively point in the same direction.

Prognosis.—The prognosis rests chiefly upon the heart-condition present. Increasing frequency of catarrhal complications, and especially of hæmoptysis, shows the turning of the balance against the patient. The condition may in favourable cases continue for years, especially when dependent upon simple constriction of the mitral valve.

Treatment.—The treatment is essentially that of the heart-disease; with the avoidance of all causes which quicken respiration, and which tend to produce catarrhs, to which these patients are so especially prone.

R. Douglas Powell.

LUNGS, Hypertrophy of.

Definition.—Enlargement of the lungs with increased functional power. A condition only clinically met with as a compensatory affection of one lung, or of a portion of one lung, to make up for more or less loss of pulmonary tissue by disease.

Ætiology and Pathology.—The process by which hypertrophy of the lung comes about is almost a mechanical one. Destructive disease having removed a large portion of one lung, or permanent collapse or blocking of such portion having occurred from any cause, the diminished power of the affected lung to occupy its apportioned space in the chest-cavity during inspiration, is compensated for by an increased expansion of the healthy lung, together with a certain recession of the softer parts of the chest-wall on the affected side. The increased expansion of the healthy lung encourages an increased afflux of blood, and an increased current of blood is at the same time propelled through it, owing to the partial obstruction to circulation through the diseased lung. These changes taking place gradually, the increased function and increased afflux of blood are, in accordance with our experience of similar conditions in other parts, attended with increased nutrition of the lung, and a true hypertrophy of it is thus little by little established.

Hypertrophy of the lung, therefore, is not a diseased condition, but an excessive development in consequence of injury to some other portion of the same or of the opposite lung. Its occurrence may be best noted during the gradual absorption or removal of a pleural effusion, which has long compressed the opposite lung. Any disease, however, which, after destroying or placing in abeyance a certain proportion of one lung, becomes arrested, tends to cause hypertrophous development of the remaining lung. Chronic pneumonia, cirrhosis, arrested phthisis, and atelectasis in the child, are the chief diseases of the kind. While disease is actively progressive, the conditions present—namely, fever, anorexia, and pleuritic pains—are unfavourable to the extra-development of the sound lung; but when these unfavourable conditions subside, the hypertrophy proceeds with great rapidity, and may be established in a very few months. The effect of the rarefied air of mountainous regions is to develop the natural capacity and function of the lungs.

Anatomical Characters.—An hypertrophied lung is larger and heavier than natural; and its anterior and inferior margins are thick and rounded, and are found to extend beyond their normal thoracic limits both laterally and inferiorly. The texture of the lung is firmer and more resilient than usual; and it is plentifully supplied with blood. The air-cells are slightly enlarged, but not obviously dilated. On microscopic examination the nutrition of the alveolar walls and capillaries is found to be perfect; there being neither the thinning of the alveoli, nor the excessive growth of fibrous tissue met with at different stages of so-called 'hypertrophous emphysema.' Nor are the capillaries tortuous and dilated, as in the indurative 'hypertrophy' of the lung from heart-disease.

Extent of lung affected.—We have considered, for the sake of simplicity of description, those cases in which the whole of one lung is hypertrophied, and such cases are very common. But a single lobe of a lung may become hypertrophied, the seat of the hypertrophy depending upon the seat of the disease to which it is compensatory. However, unless the pulmonary destruction is limited and circumscribed, other conditions come into play, and we are more likely to get emphysema than hypertrophy. It may be said then that hypertrophy of the lung is (at least so far as we can appreciate it clinically) a one-sided affection, except in those cases in which it has been occasioned by some general external cause, as rarefied air.

Physical Signs.—The side on which is the hypertrophied lung is expanded, both relatively (the opposite side being usually flattened and contracted) and absolutely. The nipple-level is raised. There is increased percussion-resonance over the side, extending across the median line, so that sometimes the line of resonance indicating the inner margin of the enlarged lung will reach the mid-clavicular vertical line of the opposite side. The lower limits of resonance are also extended in front and behind. The respiratory murmur has that peculiar coarse vesicular character, with somewhat prolonged expiration, which is known as 'puerile' or 'exaggerated' respiration. The heart is more or less displaced towards the contracted side, and the displacement is often apparently increased by the heart becoming on the one side covered by the expanded lung, and on the other side unduly exposed by the recession of the diseased lung. This is especially the case when the hypertrophy affects the left lung. There are no morbid sounds heard over the enlarged lung unless (as in many cases of phthisis) it becomes or has been affected by disease. With the expansion of the lung the general symptoms improve, and the dyspnœa lessens.

Diagnosis.—The diagnosis must be made between hypertrophy of the lung; hypertrophous emphysema; and mere dilatation. The unilateral nature of the hypertrophy; its arising secondarily to some disablement of the opposite lung; the absence of preceding or present general bronchitis or asthma; together with the observation of its occurrence being commensurate with improvement in the condition of the patient, are the main features distinguishing it from large-lunged or hypertrophous emphysema. Nor could the puerile breathing of hypertrophy be easily confounded with the short, weak, or inaudible inspiration and wheezy prolonged expiration of emphysema. In persons of broken-down constitution, with contractile disease of one lung, the opposite lung may become dilated, and assume the shape and dimensions of hypertrophy; but the breathing of the patient does not improve, the respiratory sounds are enfeebled, and it is clear that the condition present is one of emphysema rather than true hypertrophy.

PROGNOSIS.—The prognosis is always *pro tanto* favourable to the patient, the hypertrophy being an important element of his recovery.

TREATMENT.—Compensatory hypertrophy of the lung is a condition carefully to be encouraged, when all active symptoms attendant upon the original disease are past. Mild courses of calisthenics, and a temporary sojourn at some elevated health-resort during the warm season, are most valuable, if not attempted too soon. Abundance of fresh air throughout the year, with the careful avoidance of fresh catarrhs, such as may be obtained by spending a winter and spring or two seasons in the South of France, in Italy, or at Madeira; or a well-planned sea-voyage to Australia, are the most useful requisites during the months of convalescence. A generous unstimulating diet is indicated, and tonic remedies and cod-liver oil are useful, more especially in the early stages of the wished-for hypertrophic development.

R. DOUGLAS POWELL.

LUNGS, Induration of.—*See* LUNGS, Inflammation of.

LUNGS, Infarction of.—*See* LUNGS, Hæmorrhage into.

LUNGS, Infiltrations of.—Certain morbid formations in the lung assume the arrangement of an infiltration, the tissues, especially the interlobular cellular tissue, being permeated with the morbid material. In some instances it involves even the epithelial cells. The best examples of this mode of distribution are observed in connexion with certain cases of pulmonary fibrosis; in infiltrated cancer; and in those forms of disease where the lung-tissue is the seat of a deposit of substances introduced from without, being inhaled in various occupations, such as carbonaceous matter and coal-dust, stone-grit, iron-filings, particles of cotton or wool, and other materials. Albuminoid disease, and some forms of pigmentary change, also present a kind of infiltrated arrangement. These conditions need not be further considered here, as they are discussed in their several appropriate articles.

FREDERICK T. ROBERTS.

LUNGS, Inflammation of.—SYNON.: Pneumonia; Fr. *Pneumonie*; Ger. *Lungenentzündung.*

DEFINITION.—The term 'pneumonia' has been employed simply to designate inflammation of the lung-tissue. Inflammatory processes in the lungs, however, occur under such diverse circumstances, and are accompanied by such diverse clinical phenomena and histological changes, that 'pneumonia' used in this sense includes widely different diseases.

VARIETIES.—Pneumonias are divisible into the following varieties: A. **Acute Pneumonia**; B. **Secondary Pneumonia**; C. **Broncho-, Catarrhal,** or **Lobular Pneumonia**; and, D. **Chronic** or **Interstitial Pneumonia.** In addition to these there are those intense and concentrated forms of pulmonary inflammation which lead to the formation of *abscess.*

There are certain other forms of lung-consolidation which have sometimes been described as pneumonic, but which are really, for the most part, non-inflammatory in their nature, and will, therefore, be only briefly alluded to in the present article. These are: (1) that condition of collapse and hyperæmia, mainly due to weak inspiratory power, feeble circulation, and gravitation, which is so common in the more dependent portions of the lungs in many acute and chronic diseases. (2) Consolidations of the lung resulting from mechanical congestion and embolism, such as are met with in certain diseases of the heart.

The several varieties of pulmonary inflammation must now be considered separately, in the order just indicated.

Pulmonary abscess is separately described. *See* LUNG, Abscess of.

A. **Acute Pneumonia.**—SYNON.: Fr. *Pneumonie Aiguë*; Ger. *Croupöse Pneumonie.*—This is pneumonia *par excellence.* It is the disease to which the writer would be inclined to restrict the application of the term. It is sometimes termed *croupous* pneumonia, from the supposed resemblance of the histological process to that of croup. It is also known as *lobar* pneumonia, inasmuch as a large area of the lung is usually involved in the inflammation.

DEFINITION.—Pneumonia may be described generally as an acute disease, characterised clinically by sudden onset, severe febrile symptoms, cough, expectoration, and dyspnœa; by the physical signs of pulmonary consolidation; and by a rapid abatement of the general symptoms between the fourth and tenth days. Anatomically it is characterised by an acute inflammation of the lung-tissue, and by the accumulation of the inflammatory products within the alveoli, which products consist, in the main, of a fibrinous exudation and leucocytes.

Ætiology.—*Age.*—No age is exempt from pneumonia. It is met with between the ages of one and five years. Here, however, it is liable to be confounded with broncho-pneumonia and with collapse of the lung, so that the results of statistics are less reliable at this than in the subsequent periods of life. It may be stated, notwithstanding, that pneumonia is less common during infancy than has been generally supposed, and that amongst the pneumonias which are so frequent during this period of life the broncho-catarrhal forms preponderate. After the age of five years the liability to pneumonia diminishes, but it again becomes exceedingly frequent between the ages of twenty and forty, during which period the liability to the disease reaches its maximum. It is also quite common in old age.

Sex.—In adults more males than females suffer. This is probably owing to the former being more exposed to atmospheric influences. In early life this difference does not obtain.

Social position, &c.—Pneumonia is more common amongst the poor and badly fed, and amongst those whose occupation necessitates an irregular mode of life and great exposure, than amongst the upper classes of society.

Constitution, and health.—Those who are constitutionally weak, and those whose vitality has been impaired by intemperance, insufficient food, anxiety, overstrain, or other causes, are more prone to the disease than the strong and vigorous.

Climatic influences.—Conditions of weather and climate are probably the most important of all known agencies in the causation of pneumonia, and 'catching cold' is the most common exciting cause of the disease. The influence of cold and damp in increasing the liability to acute inflammatory diseases of the chest is well known. This influence is marked in pneumonia, although to a much less extent than in bronchitis and pleurisy. Pneumonia is more common in temperate climates than in those regions which are characterised by great heat or extreme cold. Climates and seasons which are liable to sudden changes of temperature, and winds from the north and north-east, appear to be especially favourable to the development of this disease.

Epidemic influences and contagion.—Pneumonia sometimes prevails epidemically; it is occasionally endemic in a house; and under certain circumstances, at present unknown, evidence tends to show that it may be communicated from one person to another. Such facts tend to support the view—the most probable in the present position of our knowledge—that some micro-organism is concerned in the causation of the disease.

Septic causes.—Sewer-gas emanations appear to play some part in the causation of certain cases of pneumonia. Such cases are said to differ somewhat in type from ordinary pneumonia, and have been termed *pythogenic.*

Previous diseases.—Pneumonia, as is well known, often occurs in those who are the subjects of other disease. It is impossible to speak with certainty as to the relation which subsists between the pneumonia and the disease in the course of which it supervenes. In some cases it may be merely an accidental complication; whilst in others the previous disease may exercise more or less influence in the causation of the pneumonia. Most of the pulmonary consolidations, however, which occur in the course of other diseases do not belong to the category of true pneumonia, but are either local inflammations, caused by some abnormal state which the pre-existing disease has induced, or conditions of hyperæmia and collapse, in which an inflammatory process plays but little part.

Exciting causes.—In many cases of acute pneumonia evidence of the existence of any exciting cause is entirely wanting. Of discoverable causes, that which is most common is a sudden chill, or, less frequently, more prolonged exposure to cold and damp. Excluding cold, no conditions can be mentioned which have any marked influence in determining the disease.

Anatomical Characters.—The changes occurring in the lungs in acute pneumonia are commonly described as consisting of three stages:—

1. *Stage of engorgement.*—This is the stage of inflammatory hyperæmia and œdema, and it is characterised microscopically by overfulness and slight tortuosity of the pulmonary capillaries, and by swelling of the alveolar epithelium. The lung is of a dark red colour; it is heavier and less crepitant than natural; it pits on pressure; and its cut surface yields a reddish, frothy, tenacious liquid.

2. *Red hepatisation.*—Here there is an exudation of liquor sanguinis and blood-corpuscles. The exuded liquids coagulate within the alveoli and terminal bronchioles, the coagulum enclosing numerous white and a few red blood-corpuscles. The alveolar epithelium is swollen and granular. It is stated by some German pathologists that the coagulum is in part produced by certain changes in the epithelium like those believed to occur in croup. The lung is now much heavier than in the preceding stage, and is increased in size, so as to be often marked by the ribs. It is quite solid; sinks in water; and cannot be artificially inflated. It is remarkably friable, breaking down with a soft granular fracture. The cut surface has a markedly granular appearance, seen especially when

the tissue is torn, and due to the plugs of coagulated exudation-matter which fill the alveoli. The colour is of a dark reddish-brown, often here and there passing into grey. This admixture with grey sometimes gives a marbled appearance. The pleura covering the solid lung always participates more or less in the inflammatory process. It is opaque, hyperæmic, and coated with lymph.

3. *Grey hepatisation.*—This stage is characterised by a continuance of the process of inflammatory cell-emigration, and by more marked changes in the epithelium. The white blood-corpuscles continue to escape from the vessels, and the alveolar epithelium becomes more swollen and granular. The alveoli thus become more completely filled with young cell-forms, so that the fibrinous exudation is no longer visible as an independent material. Many of these cells, especially those in the vicinity of the alveolar walls, are larger than leucocytes, and nucleated. These are evidently the alveolar epithelium. The fibrinous exudation now disintegrates, and the young cells rapidly undergo fatty metamorphosis. The alveolar walls themselves, with few exceptions, remain throughout the process unaltered; although very occasionally, when this stage is unusually advanced, they may be found here and there partially destroyed. Owing to these changes, the reddish-brown colour of the lung becomes altered to a greyish or yellowish white. The granular appearance is much less marked; the solid tissue is much softer and more pulpy in consistence; and a puriform liquid exudes from the cut surface of the organ. This stage, when advanced, has been termed 'suppuration or purulent infiltration' of the lung.

Although these three stages of the pneumonic process have been described as succeeding one another in orderly succession, it must be remembered that each stage does not occur simultaneously throughout the whole of the affected area of the lung. The changes advance irregularly, so that whilst one portion of the lung is in the stage of red hepatisation, another may be in the grey stage—hence the mottled, marbled appearance of the consolidation. The rapidity with which the several stages succeed one another is also subject to marked variations. In some cases the pneumonic consolidation very rapidly becomes grey, whilst in others the time occupied in the transition is much longer. These differences will be again alluded to when considering the clinical history of the disease.

Terminations.—The natural and almost invariable termination of the histological process is in *resolution*—the lung gradually returning to its normal condition. This is effected by the fatty and mucoid degeneration, and consequent liquefaction, of the inflammatory products which have accumulated within the alveoli. As the liquefaction proceeds, the circulation in the alveolar walls is gradually restored; the softened products are removed by absorption, and to a much less extent by expectoration; and the lung ultimately regains its normal characters. The other exceptional modes of termination in *gangrene*, *abscess*, and *chronic pneumonia* will be alluded to subsequently.

Site.—The local lesion in pneumonia is in the majority of cases limited to one lung. When double, one lung is usually involved before the other. The right lung is more commonly affected than the left. The part of the lung usually involved is the lower lobe (about 75 per cent.). The consolidation may extend upwards and implicate the whole lung. Pneumonia of the upper lobes is more frequently double than basic disease. It is quite rare for the pneumonic process to commence in two different portions of the lung. When the consolidation is met with in both lungs, or commencing in the upper and middle lobes, the pneumonia is often a secondary affection, and has supervened in one whose health has been previously injured, as by alcohol; and such distributions of the local lesion should always make the physician look carefully for evidence of pre-existing disease.

PATHOLOGY.—The old view that pneumonia is a simple local inflammation accompanied by a symptomatic pyrexia, would appear to be no longer tenable; and although a complete pathology of the disease must await further investigations, the present position of our knowledge makes it in the highest degree probable that it is a *general infective disease*, closely allied to the acute specific fevers, of which the lung-inflammation is the characteristic local lesion. What is known of the ætiology of the disease, the absence of any constant relation between the local inflammation and the intensity of the fever, the 'typical' course of the fever, the fact that the disease is incapable of being produced by mechanical or chemical injuries of the lung, and, lastly, the discovery of peculiar micro-organisms, all tend to support this view of its pathology.

Micro-organisms.—During recent years certain organisms have been described by various observers in connexion with pneumonia, which are supposed to be the causes of the disease. Friedländer demonstrated the almost constant presence in the exudation and lymphatics of the lung of oval, short rod-shaped cocci, contained in oval capsules, from two to four or more in each capsule. Subsequently Fränkel and Weichselbaum described the presence in pneumonic lungs of another 'capsule-coccus,' the *diplococcus pneumoniæ*. This consists of round or oval cells, usually in pairs, but often in chains. This coccus is believed by Baumgarten to be constantly present in the pneumonic lung, and it is also found in the blood. Whether either of these organisms is to be regarded as a cause of the disease, or only as an accidental parasite, is at present quite uncertain, the results of cultivation and inoculation being thus far inconclusive. But, as already stated, the present position of our knowledge points to the probability of some specific organism or organisms being concerned in the causation of the disease. *See* MICRO-ORGANISMS.

SYMPTOMS.—The onset of pneumonia is in the majority of cases sudden, not being accompanied by any premonitory symptoms. Much less frequently, certain premonitory symptoms precede the more severe phenomena which characterise the invasion of the disease. These symptoms include general malaise, headache, chilliness, pains in the back, and loss of appetite.

Invasion.—The invasion in adults is, in most cases, announced by a rigor, much less frequently by vomiting. This rigor is more marked in pneumonia than in almost any other disease. It is usually single, and is rarely repeated, either at the commencement or in the course of the illness. In old subjects the rigor is very frequently absent, and in children its place is often taken by convulsions or vomiting. The rigors or other phenomena marking the invasion of the disease, together with the attendant pyrexia, are usually quickly followed by symptoms pointing to the lung-affection. These symptoms commonly supervene in the course of from twelve to twenty-four hours, although in exceptional cases not until after the lapse of two or three days. The earliest of them are pain in the side, dyspnœa, and cough. These more local symptoms, together with the pyrexia, acceleration of pulse, thirst, and prostration, gradually develop up to the second day of the disease, by which time (and sometimes before this) the pulmonary lesion is usually sufficiently advanced to yield unequivocal physical signs. The general aspect and symptoms of the patient are now tolerably characteristic. The flushed and sometimes dusky face, anxious expression, hurried breathing, hot skin, rapid pulse, short frequent cough, and marked prostration, supervening quickly upon the well-marked initial rigor, indicate pretty clearly the nature of the disease.

Pain.—The pain in the side, which is increased by deep inspiration and by cough, usually corresponds in situation with that of the affected lung, although it is occasionally experienced in other parts. This symptom may occur coincidently with the rigor, although it more commonly succeeds it. In quite exceptional cases it precedes it, being the first symptom noticed. The pain is due to the implication of the pleura in the inflammatory process; and its severity consequently varies considerably according to the extent and situation of the pulmonary lesion. When this is confined to the central portions of the lung, pain may be entirely absent.

Respiratory phenomena.—Increased frequency of respiration, dyspnœa, and cough, are early and prominent symptoms. The respiration—usually regular—ranges from 30 to 50, and in children reaches even to 70, whilst the pulse may be only from 90 to 120. This perversion in the pulse-respiration ratio is important in diagnosis. The breathing is shallow; inspiration is abrupt; and, when the pain in the side is severe, respiration is sometimes irregular. The accelerated respiration is accompanied by marked expansion of the *alæ nasi*, and by more or less dyspnœa. There is, however, no definite relation between the last-named symptom and the frequency of the respiratory act. Owing to the pain, and to the frequency and difficulty of breathing, speech may be interfered with, and is often rendered exceedingly difficult. Cough is an almost constant symptom, except in the very old. It is short and hacking, rarely paroxysmal like that of bronchitis. It is usually in the early stages attended with severe pain in the side, so that the patient endeavours to repress it. The cough is usually attended by expectoration; but in children and the old expectoration is often absent, and occasionally such is the case at other periods of life, even throughout the whole course of the illness. The sputa of pneumonia are very characteristic. They are viscid, glairy, and remarkably tenacious, so that they cling to the mouth of the patient, and adhere closely to the sides of the vessel containing them. In colour, they present various shades of red, brown, and yellow, owing to the admixture of blood. The appearance so well-known as 'rusty' is that most commonly met with. Sometimes they are much more diffluent, and of a dark purple colour, somewhat resembling prune-juice. The characteristic sputa are usually met with on the first or second day of the disease, but their appearance is often preceded by a frothy aërated expectoration, like that of bronchitis. The amount expectorated is small, and sometimes the pneumonic is associated with more or less of the frothy catarrhal sputa throughout the whole of the disease. During the period of resolution the sputa become less viscid, and more catarrhal in character, and they usually contain small particles of black pigment. The histological elements met with in the sputa are leucocytes, red blood-cells, and altered epithelium from the alveoli and air-passages; and towards the decline of the disease, fat-granules, pigment, and occasionally fibrinous masses, which are casts of the alveoli and terminal bronchioles.

Pulse.—The pulse in adults usually ranges from 90 to 120, and may be even more frequent. It is commonly much more rapid in children, and less so in the old. In the early stage of the disease it is often full and strong, but soon becomes smaller and easily compressible. It may be irregular, intermittent, or dicrotous. The smallness of the pulse is probably due partly to diminished cardiac power, and partly to the diminished amount of blood which is propelled from the left ventricle, owing to the overloading of the right cardiac cavities which results from the obstructed circulation in the lungs.

Pyrexia.—The pyrexia of pneumonia is continuous, with slight morning remissions and evening exacerbations. The temperature rises very suddenly, with the invasion of the disease, to from 102° to 105° F.; and this high temperature is usually maintained until the period of crisis. This sudden rise and maintenance of a high temperature is very characteristic. The amount of elevation varies in different cases. As a rule, it does not exceed about 104° or 105° F., but temperatures of 107° have been known to terminate favourably. In fatal cases it may reach 109° shortly before death. The maximum temperature is usually met with on the second or third day of the disease, but it occasionally occurs immediately before the crisis. The daily variations are usually as follows: The temperature is lowest about 7 or 8 A.M. In the forenoon, or somewhat later, it commences to rise, and attains its maximum in the early evening. It then falls, but a slight exacerbation occasionally occurs again at midnight, after which it gradually falls. The difference between the highest and lowest temperatures is usually not more than 1° F. The pyrexia runs, for the most part, a uniform course until the period of crisis, when the temperature falls rapidly, in the manner to be hereafter described; but in exceptional cases the course of the fever is much more irregular.

Nervous system.—Headache, restlessness, and sleeplessness are almost always prominent symptoms in pneumonia. Slight delirium is also common, especially towards evening, when the pyrexia is at its maximum. Sometimes the delirium is more marked and violent. It constitutes a more prominent symptom in the old, and in the debilitated and intemperate. In drunkards it is constantly present, and here it often assumes the character of delirium tremens. Convulsions are common in children, especially at the period of invasion. They are rare in the adult. These nervous symptoms are sometimes so prominent as to mask the nature of the disease.

Digestive organs.—The symptoms of pneumonia referable to the digestive system are similar to those met with in other severe febrile diseases. There is thirst, with loss of appetite. The tongue is more or less thickly coated with a white fur, and it tends in severe cases to become dry and brown. Herpes usually makes its appearance about the lips, and sometimes on other parts, from the second to the fourth day of the disease. Vomiting, which is a common symptom of invasion, is an occasional complication, as is also diarrhœa; constipation, however, is the rule. Sometimes there is slight jaundice.

Urine.—The quantity of urine is considerably diminished, and its specific gravity increased, so that abundant urates are deposited. The excretion of urea is greatly increased, and it may amount to as much as seventy-five grammes in the twenty-four hours. The uric acid is likewise augmented. The chlorides are much diminished, and during the height of the disease may entirely disappear. Slight temporary albuminuria is perhaps more common in pneumonia than in almost any other acute febrile affection. The amount is usually in direct proportion to the severity of the disease. Bile-pigment is occasionally met with.

PHYSICAL SIGNS.—The earliest physical signs of pneumonia are usually discoverable within forty-eight hours of the invasion of the disease. They often appear within twelve or twenty-four hours; but occasionally, when the local lesion is deeply seated, nothing abnormal is to be detected until the third or fourth day. It will be well to describe them in the order in which they commonly make their appearance. The time occupied in their evolution will vary according to the rapidity with which the several stages of the pneumonic process succeed one another; and it must be remembered that only some of them are usually observed in practice. In a large number of cases, bronchial breathing and some impaired resonance (the two signs most frequently met with) are the only abnormal signs discoverable.

The earliest abnormal physical signs are due to the pain caused by the movement of the affected side; to the hyperæmia of the pulmonary capillaries; and to the commencing exudation into the air-vesicles. The respiratory movements of the side are more or less impaired. This is partly owing to pain, and partly to diminished elasticity of the lung-tissue. The breath-sounds are usually somewhat weak and harsh, but not distant; although, as stated by Stokes, they are occasionally in the earliest stage harsher and louder than natural. Percussion during this stage is usually not markedly altered. The resonance, however, in the upper portions of the chest is sometimes appreciably tympanitic in quality. The vocal fremitus is increased. The most important sign, however, of the congestive stage is *fine crepitation.* This *râle* consists of a number of fine, dry, crackling sounds, following one another in rapid succession, which were aptly compared by the late Dr. C. J. B. Williams to the sounds produced by rubbing the hair between the fingers close to the ear. It occurs during the later period of this stage, when the process of exudation from the pulmonary capillaries is commencing to take place. Its production is probably due to the partial agglutination of the walls of the air-vesicles, and their forcible separation during the inspiratory act.[1] The *râle* is almost exclusively limited to inspiration. It is intensified by deep inspiration and also by cough, and it is sometimes necessary to make the patient cough in order that it may be produced. A precisely similar *râle* is often heard with deep inspiration in portions of the lung which have been imperfectly expanded. Such imperfect expansion is common in the posterior parts of the lungs of patients who have been confined to bed from acute or chronic disease, and in whom, owing to muscular weakness, inspiration is incompletely performed. The *râle* produced under these circumstances is distinguished from pneumonic crepitation inasmuch as it completely disappears after a few deep inspirations; whereas the pneumonic *râle*, when once established, persists until the consolidation of the lung is tolerably complete.

The physical signs of the stage of hepatisation are due to the more or less complete consolidation of the lung. The fine crepitation which characterised the later periods of the preceding stage continues during the process of consolidation, but ceases as the filling of the air-vesicles becomes complete; although it may often still be heard at the confines of the more firmly consolidated lung. It occasionally happens, however, when the consolidation is very rapidly induced, that no crepitation is heard throughout the course of the disease until the period of resolution. The situation of the cardiac impulse is not altered. The vocal fremitus is usually increased. To this general rule, however, there are exceptions, and it not infrequently happens that it is unaltered, and it may even be completely absent. This diminution in the vocal fremitus is sometimes due to the blocking of the smaller bronchi with the inflammatory exudation, but more frequently it appears to result from an accumulation of mucus. In the latter case it may sometimes be restored by cough. Coincidently with the increase of vocal fremitus there is usually increased vocal resonance, and sometimes whispering pectoriloquy (Walshe and Wilson Fox). The percussion-sound now is much more deficient in tone, and it is often more or less amphoric. There is also a great increase in the sense of resistance, but neither the dulness nor the resistance is so marked as in pleural effusion. In basic disease, percussion under the clavicle often yields a distinctly amphoric note, whilst the lower portions of the chest may be almost absolutely dull. The auscultatory sign of this stage is bronchial breathing. This is usually remarkably superficial, high-pitched, and metallic in quality (tubular breathing). Sometimes, however, it is less metallic and softer (diffused blowing —Walshe). These respiratory phenomena, like the vocal resonance and fremitus, may be absent over larger or smaller areas of the consolidated lung, owing to the obstruction of the bronchi by catarrhal secretion. The slight pleurisy which constantly accompanies the pneumonia is rarely susceptible of physical demonstration during this stage. This is probably owing to the immobility of the solid lung. During the period of resolution, as expansive power returns, friction-sounds are occasionally audible.

Resolution usually commences in those portions of the lung which were the last to become consolidated. The most important and the earliest of the signs of resolution is the return of crepitation. The crepitation, however, differs from that met with in the earlier stages of the disease. It is larger, coarser, and more liquid in character—*redux crepitation*; and its liquid character gradually increases until it may become distinctly bubbling. When resolution is very rapid, redux crepitation may be absent (Wilson Fox). The bronchial breathing now loses its metallic ringing quality; the percussion-dulness gradually disappears; and the respiration regains to a great extent its normal characters.

The commencement of resolution and of the improvement in the physical signs occasionally takes place coincidently with the establishment of crisis; but more commonly it is not observed until from twenty-four to forty-eight hours after the temperature has reached the normal standard. The time occupied in the completion of resolution varies. Sometimes all physical signs almost completely disappear in twenty-four hours. Usually, however, resolution is less rapid, and marked signs of consolidation remain for periods varying from two or three days to two weeks. A slight amount of dulness and some weakness of respiration often persist at the posterior and inferior portions of the lung for even still longer periods. This is especially the case if the pneumonia is complicated with pleurisy. When marked signs of consolidation exist after the third week, there always exists more or less probability that the pneumonic process may become chronic.

Course and Terminations.—The symptoms which have been described continue with often increasing severity up to about the end of the first week, sometimes longer, when there is usually an abrupt subsidence of the pyrexia—*crisis*, and the disease generally terminates in *recovery*. In other cases *death* occurs either before or after the crisis. The disease may also terminate in *gangrene* of the lung; in pulmonary *abscess*; or in *chronic pneumonia*. These several modes of termination must be considered separately.

---

[1] This sound is well illustrated by that emitted in the crackling of bubbles in a viscid liquid such as beer poured into a glass. The sound may be explained by supposing that a thin layer of the viscid fluid is drawn across the orifice of the air-vesicle during inspiration to form an operculum, which is immediately ruptured.—Editor.

Complete recovery.—This is the most common termination of pneumonia in young and healthy adults, and the improvement usually begins with the *crisis*. The time at which this crisis takes place, as indicated by the sudden fall of temperature, varies from the third to the twelfth day. In the majority of cases it is on the fifth, sixth, or seventh day; occasionally as early as the third day; and sometimes it is prolonged into the middle of the second week.

The supervention of the crisis in pneumonia is sometimes indicated by a change in the pulse, which becomes softer, and somewhat irregular in force and rhythm. The most marked phenomenon attending it is the abrupt fall of the body temperature. This fall usually begins late in the afternoon or evening; and the temperature very often reaches the normal standard in from sixteen to twenty-four hours, usually within forty-eight hours; the morning remission and evening exacerbation occurring during the period of defervescence. The temperature not infrequently falls 1° or 2° F. below normal, and may remain so for two or three days. Occasionally a marked increase in the pyrexia is observed immediately before the commencement of defervescence.

With the fall of temperature all the symptoms rapidly improve. The skin becomes moist and often perspires profusely. The amount of urine increases. The respiration falls in frequency; and, to a less extent, the pulse. The cough becomes looser, and the expectoration more copious. The sputa gradually lose their tenacity and rusty colour, and become more bronchitic in character; they are now usually mingled with more or less black pigment. An improvement in the physical signs is sometimes observed at the same time; more commonly, however, this does not take place till one or two days later. The patient often falls into a deep sleep, and on waking, with the exception of great weakness, declares himself pretty well, and begins to ask for food. In some cases, however, the amount of prostration following the crisis is so great that the return to health is more gradual; and a condition of collapse may ensue, which often terminates in death. There is a liability to diarrhœa at this period which it is all-important to bear in mind.

In the majority of cases pneumonia terminates abruptly in the manner above described. Sometimes, however, the temperature falls more gradually—by *lysis*; and recovery is more protracted. Defervescence may not be complete till the end of the second week. The critical fall of temperature is occasionally interrupted by more or less marked exacerbations, due either to the implication of fresh portions of the lung, or to the supervention of one of the complications to be hereafter alluded to.

In some cases, after the occurrence of crisis, there is a slight return of fever of a hectic type. This irregular fever, which may last from three or four days to a fortnight, is probably due to the contamination of the blood by the absorbed pneumonic products (Parkes). Lastly, a distinct relapse may occur after the completion of crisis; but the relapse is in most cases shorter and less severe than the primary attack.

Death.—When pneumonia terminates fatally, it usually does so towards the end of the first, or quite at the beginning of the second week, and often *after* crisis. Death is commonly due mainly to failure of cardiac power, and partly to apnœa. Apnœa is the least important element in the causation of dissolution. The danger from it increases with the extent of lung involved, and it is consequently usually greater in double than in unilateral disease. Failure of cardiac power is undoubtedly the most important means by which pneumonia destroys life. There are several conditions in the disease which tend to damage the contractile power of the heart. First and foremost of these is that damage to the tissues generally which occurs in all acute febrile, and especially in acute infective, diseases. This damage is prominent in pneumonia, which, although a disease of short duration, is severe whilst it lasts. Then, again, the condition of the lung itself constitutes another element tending to damage the contractile power of the heart, and especially of the right ventricle (Juergensen). The lung-consolidation not only presents more or less obstruction to the pulmonary circulation, and hence necessitates increased action on the part of the right ventricle; but, owing to the diminished respiratory surface, this ventricle is obliged to do more work in order that the proper interchange of gases may be effected in the lungs.

Such being the modes by which pneumonia tends to destroy life, it will be readily understood that the earliest and most important signs of unfavourable augury are on the side of the circulation. The pulse becomes more frequent, small, irregular, and often dicrotous. The frequency of the respiration, the dyspnœa, and the cyanosis increase. The cough becomes feeble and ineffectual. Owing to the engorgement and failure of power of the right ventricle, general pulmonary œdema usually supervenes, so that moist *râles* are audible at both bases. The extremities become cold, and there is often profuse perspiration. The mind wanders, and a condition of partial coma supervenes before the close. In some cases a rapid rise of temperature takes place before the fatal termination, whilst in others there may be a considerable fall in the thermometer. In those exceptional cases in which pneumonia tends to become more or less chronic, death may occur during the third or fourth week. Death may also result from the complications.

Gangrene.—This is quite rare. It is most common in chronic drunkards, and in those of debilitated constitution. Its occurrence appears to be due partly to blocking of vessels, and partly to the influence of septic inflammatory products. It is usually limited to a small area of the pneumonic lung; and is either diffuse, or becomes limited by a zone of inflamed tissue. It commonly supervenes late in the disease; and the most reliable signs of its occurrence are marked fœtor of the breath and the expectoration, and great prostration. Portions of lung-tissue are occasionally found in the sputa. Gangrene is almost invariably, but not necessarily, fatal. *See* Lungs, Gangrene of.

Abscess.—This is also very rare. *See* Lungs, Abscess of.

Chronic pneumonia.—Acute pneumonia in very exceptional cases becomes chronic, and leads to induration of the lung.

Varieties.—The clinical phenomena of pneumonia are occasionally somewhat different from those which have been described. Variations are met with resulting from differences in the individual, and in the ætiological factors concerned in the disease. The following varieties must be alluded to:—

(*a*) *Latent pneumonia.*—Pneumonia has been termed *latent* when the characteristic symptoms of the disease are absent, or but little pronounced; or when they are masked by some other clinical phenomena. It is in the pneumonia of the *aged* that marked latency is so often observed. Here invasion may be unattended by rigor or other prominent symptoms. The elevation of temperature is much less than in adults. Cough, expectoration, pain, and dyspnœa may be completely wanting. If cough be present, the sputa often do not present the rusty tinge, but are simply transparent or mucopurulent. Slight pyrexia, with some increased frequency of breathing and prostration, may be the only symptoms present. This latent course of pneumonia it is important to bear in mind, as it indicates the necessity of making a most careful physical examination of the chest in all febrile illnesses of the aged. In the pneumonia of drunkards and of young children, also, the accompanying nervous phenomena may be so prominent as to mask the nature of the disease.

(*b*) *Asthenic* (*typhoid*) *pneumonia.*—When pneumonia occurs in those who are debilitated by previous disease, by the abuse of alcohol, by age, by privation, or other causes, the phenomena of invasion are usually not pronounced, and symptoms of intense prostration occur early. In many respects the course of the disease closely resembles that which has been just described as so common in the aged. The initial rigor and pain in the side are often observed; but cough is slight; and the expectoration, instead of the rusty-brown tint, may present a dirty-brown or prune-juice appearance. Various symptoms of an asthenic type soon become prominent; the most important of which are low delirium, alternating with stupor; tremors; and paralysis of the sphincters. The tongue is brown and dry; sordes form on the teeth; the pulse is exceedingly rapid and feeble; and there are often slight jaundice and albuminuria. Death usually supervenes some time during the second week of the disease. After death the lung is usually found to be less firmly consolidated and less granular than in sthenic forms of pneumonia. The stage of grey hepatisation in some cases is exceedingly advanced, constituting what has been termed 'suppuration' of the lung (Sturges).

(*c*) *Intermittent pneumonia.*—An intermittent variety of pneumonia is sometimes met with in malarial districts, which appears to be one of the results of malarial infection. According to Grisolle, it occurs in intermittent and remittent forms. The former is characterised mainly by the complete intermissions which occur in the pyrexia. The temperature falls suddenly at the end of twenty-four hours; profuse sweating occurs; and the physical signs of the pneumonia almost entirely disappear. A return of the pyrexia and physical signs takes place at the expiration of twenty-four or forty-eight hours, followed by another intermission, and this by a third or fourth, the disease presenting either a quotidian or a tertian type. Both lungs are liable to be involved. In the remittent form there is a much less complete disappearance of the physical signs during the remission.

(*d*) *Pythogenic pneumonia.*—This term has been applied to certain cases of pneumonia, in which sewer-gas emanations appear to be concerned in the causation of the disease. Such cases are said to be characterised by a more prolonged and fluctuating pyrexia (Douglas Powell). Some of the cases thus described are probably pyæmic.

Complications.—*Pleurisy.*—Pleurisy of slight intensity, and unaccompanied by effusion, is, as already stated, almost invariably met with in pneumonia over those portions of the lung which are consolidated. This is natural to the disease, and cannot be regarded as a complication. Pleurisy of greater intensity, and attended by effusion, occurs in from 5 to 15 per cent. of the cases. Signs of effusion are not usually discoverable before the third or fourth day of the disease. The amount of liquid varies with the extent of the lung-consolidation. When this is considerable, involving nearly the whole lung, there is but little room for effusion. The supervention of pleurisy does not commonly materially modify the course of the disease. It may, however, protract the period of defervescence. Its influence in interfering with the disappearance of the physical signs has been already alluded to. When pleurisy occurs on the side opposite to the pneumonia it constitutes a more dangerous complication.

Bronchitis.—This is also a common complication, especially in the aged and in young children. Many cases, however, which have been described as pneumonia, associated with bronchitis, have doubtless been cases of broncho-pneumonia. The bronchitis almost invariably affects both lungs. Its supervention is attended by an increase in the cough and in the amount of expectoration. When it involves the smaller tubes it constitutes a serious complication.

Pericarditis.—This is much less frequent. It may result from the direct extension of the inflammatory process from the pleura. When extensive, it is a grave complication, and greatly increases the mortality.

Jaundice.—A slight yellowish tinge of the conjunctiva, and even of the skin, is not infrequent in pneumonia, and has no clinical significance. It is probably in most cases owing to the congestion of the liver which results from the impeded pulmonary circulation—the distended portal veins pressing upon the bile-ducts. Much more extensive jaundice is also occasionally met with, which appears usually to be due to duodenal catarrh, and is attended by gastric symptoms. In other cases, especially in asthenic forms of the disease, a non-obstructive jaundice sometimes occurs, resulting from changes in the red blood-corpuscles. This is commonly associated with nervous symptoms, such as stupor, delirium, and a tendency to collapse, which are of grave prognostic import. *See* JAUNDICE.

Parotitis.—This is a very rare and exceedingly serious complication. According to Grisolle, it is usually unilateral; the inflammatory process is very acute; and commonly leads to suppuration or gangrene.

DIAGNOSIS.—The diagnosis of pneumonia, usually easy, is sometimes attended with difficulty. Although it cannot be made with absolute certainty prior to the appearance of physical signs of pulmonary consolidation, in the majority of cases a very confident opinion can be formed as to the nature of the illness in the earliest stages, before such signs are discoverable. The phenomena which are of the most diagnostic value at this early stage of the disease are the pyrexia, the altered pulse-respiration ratio, the pain in the side, and the cough. The sudden and rapid rise of the bodily temperature, which usually reaches its maximum in forty-eight hours, is very characteristic; such a rapid attainment and maintenance of a high temperature being perhaps more common in pneumonia than in any other disease (Wilson Fox). Of the other symptoms, the increased frequency of respiration, and especially the alteration in the pulse-respiration ratio, are of the most valuable diagnostic import. When physical signs of pulmonary consolidation are discoverable, which they usually are within forty-eight hours, the diagnosis becomes certain.

Difficulties in diagnosis may arise in those cases in which the local process in its earlier stages is deeply seated. Here, characteristic physical signs may be wanting for four or five days, during which time some doubt may exist as to the nature of the disease. In the aged the disease so often runs a latent course, that its existence may be easily overlooked unless a careful examination be made of the chest. Then, again, in the intemperate its nature may be masked by delirium and other nervous symptoms.

The diagnosis of pneumonia from other diseases of the lungs is rarely difficult. The disease with which it is most liable to be confounded is pleurisy; and when a pleural effusion complicates pneumonia, some care may be required to avoid error. In pleurisy, however, there is not, as a rule, such a sudden and rapid attainment of a high temperature as in pneumonia; and when effusion has taken place, the physical signs are in most cases sufficiently distinctive. In pleural effusion the displacement of the heart; the absolute dulness and sense of resistance on percussion; the weak and distant character of the respiration; and the diminished vocal fremitus and resonance, contrast with the signs of pulmonary consolidation.

Another disease with which pneumonia may be confounded is that somewhat rare form of very acute phthisis, in which a large area of the lung becomes rapidly consolidated —the consolidation being often in the main indistinguishable histologically from that met with in pneumonia. Here, however, although the whole lung may be involved, the disease usually commences in the upper lobes, so that abnormal physical signs are more marked at the apex. The onset of the disease also is commonly much less sudden, and its course is more protracted. Then, again, the rapid consolidation of the lower portions of the lungs, which sometimes supervenes in more chronic forms of phthisis, might be mistaken for the consolidation of acute pneumonia; but the history of the case, a careful examination of the upper lobes of the lungs, the irregular course of the pyrexia, and the protracted duration of the disease, will easily serve to distinguish them. It may be stated generally that, in all acute consolidations of the lung, a protracted course of the pyrexia, and the occurrence of marked exacerbations and of remissions of the fever at irregular intervals, afford grounds for the supposition that the consolidation is tuberculous.

The diagnosis of pneumonia from broncho-pneumonia and collapse of the lung will be considered when treating of broncho-pneumonia. *See* C. Broncho-Pneumonia.

Prognosis.—The mortality from pneumonia varies at different periods, the disease being more fatal in some years than in others. This is probably partly owing to variations in what is called 'epidemic influence.'

Of all the circumstances which influence the prognosis of pneumonia, that which is perhaps the most important is the state of the general health. In those whose vitality has been damaged by previous disease, by privation, or by their mode of life, pneumonia is exceedingly dangerous. The prognosis is, however, especially grave in those injured by the long-continued abuse of alcohol, the mortality being, according to Huss, from 20 to 25 per cent.

Of equal importance is the age. In healthy children the mortality from pneumonia is comparatively small. The fatality formerly ascribed to the disease at this period of life was probably owing in great measure to the inclusion of cases of broncho-pneumonia in the statistics; the latter disease being exceedingly fatal. Healthy young adults rarely die; after the age of thirty the mortality increases considerably; and in the old pneumonia is an exceedingly fatal disease.

Pneumonia is more fatal in females than in males, the mortality being in the proportion of three to two. Pregnancy renders the disease more dangerous.

The danger of pneumonia increases somewhat with the extent of lung implicated. It is, however, the implication of both lungs which renders the prognosis especially grave. With regard to the situation of the consolidation it may, perhaps, be stated generally that pneumonias commencing in the upper lobes are rather more serious than basic disease. The gradual extension of the consolidation late in the disease, and the spreading of the inflammatory process from one centre to another, constitute elements of gravity. When resolution is much protracted, the fact that the disease in very exceptional cases terminates in an indurative consolidation of the lung is not to be forgotten.

The mortality of pneumonia is greatly increased by the existence of complications. The prognostic importance of these has already been considered.

Of individual symptoms, the pulse is of chief importance. A pulse which in the adult is persistently over 120, and in the child over 140, is of grave significance. Marked irregularity in force and rhythm is also unfavourable, especially in the young. Dicrotism may occur temporarily in quite favourable cases, but if it persists it indicates danger. The variations in respiration are of less import. An extreme quickness of breathing, marked dyspnœa, and cyanosis are not uncommon in cases which terminate in recovery; at the same time, such symptoms must have more or less unfavourable significance. Sputa of a dark prune-juice colour are of somewhat evil augury; as is also an abundant liquid puriform expectoration. The indications from the pyrexia are of less prognostic value in pneumonia than in most other acute diseases. A temperature of 105° or 106° F. does not in itself indicate danger. Greater elevation is grave. In many fatal cases the temperature never attains 102°. The significance of a protracted defervescence has already been alluded to. On the side of the nervous system, it is to be remembered that slight delirium is not uncommon; but when it is marked, and especially when it occurs late in the disease, it is most grave. It is of greater significance in adults than in children. Tremors and a tendency to coma are also unfavourable. A dry, brown tongue is unfavourable, especially when associated with only a moderate degree of pyrexia. Gastric catarrh and diarrhœa add to the danger; and the liability to diarrhœa at the period of crisis, and the frequency with which it then endangers life, should be ever remembered. A slight amount of jaundice is not of bad import. The pre-existence of albuminuria, or the appearance of albumen in the urine early in the disease, is very unfavourable.

Treatment.—In considering the treatment of pneumonia, it is of the utmost importance to bear in mind the true nature of the disease. All rational and successful therapeutics must be based upon the recognition of the fact that it is not simply a local affection of the lung which we wish to influence. The 'heroic' methods of treatment by venesection, tartar emetic, &c., so much in vogue in the past, had for their object the controlling or cutting short of a simple pulmonary inflammation; hence the unfavourable results which attended them. As these methods have been abandoned, and there has existed a more correct appreciation of the pathology of the disease, the mortality attending pneumonia has diminished.

When discussing the pathology of pneumonia, reasons were adduced for the belief that it owes its origin to a specific cause. Whether this be so or no, the disease is so closely allied to the specific fevers that, in attempting to influence its course by treatment, we must be guided by the same general principles. As in these fevers, our object must be to endeavour to conduct the pneumonia to a favourable termination. We cannot arrest its progress, but we can often do very much both to maintain the strength of the patient, and to modify those elements in the disease which tend to destroy life.

The modes by which pneumonia tends to destroy life have been already considered—

that damage to the tissues generally which obtains in all acute specific diseases, and interference with the respiratory function due to the lung-consolidation. Of these, the former is much the more important, and impaired cardiac power is its most serious consequence. The natural course of the disease is also to be remembered. In the strong and robust, pneumonia usually terminates in health. It is in those who are debilitated by age, privation, mode of life, abuse of alcohol, or pre-existing disease, that such great mortality attends it. It is a question of the intensity of the disease on the one hand, and of the resisting power of the individual on the other. Such considerations as these indicate the importance not only of doing all that is possible to husband and support the strength of the patient, but also of not interfering too actively with the disease, unless circumstances arise which, if uninfluenced by treatment, would tend to prove rapidly fatal.

Such being the general principles which should guide us in the treatment of acute pneumonia, the manner in which they are to be best carried out may now be indicated.

Everything should be done to husband the strength of the patient, and the services of an efficient nurse are all-important towards the attainment of this object. Perfect rest must be enjoined, and all unnecessary speaking be forbidden. The patient should be kept in bed. The room should be large and airy; and the temperature about 60° to 62° F. It should be well-ventilated: a plentiful supply of fresh air is most important, and, although due care should be exercised in the ventilation, there is not the same necessity to keep the patient scrupulously protected from draughts as in the treatment of acute bronchitis.

The diet should be carefully regulated, nutritious, and easily digestible, consisting of milk, milk with egg, beef-tea, mutton or chicken broth, meat-essences, and such-like articles, given in varying quantities and at varying intervals, according to the condition of the patient. With the object of stimulating the secretion of saliva and promoting the appetite, it is well to keep the mouth cleansed with glycerine and lemon-juice. Some acid and bitter drink, as one made with hydrochloric acid and orange-peel, may also be given.

If in the earliest stage of pneumonia there is great constipation, loaded tongue, nausea, or other gastric symptoms, the administration of a small dose of calomel, or of blue pill and colocynth, is often followed by marked improvement, both in the power to take food, and in the general condition of the patient. The exhibition of purgatives, however, requires great care, as they occasionally set up a catarrhal condition of the intestine, and consequent diarrhœa, which may prove more or less persistent. It is important, therefore, except in such cases as those above indicated to procure all necessary evacuation of the bowels, by a small dose either of castor oil, or of colocynth and hyoscyamus, or by simple enemata. With the object of promoting elimination by the skin and kidneys, some solution of acetate of ammonium with citrate of potassium may usually be prescribed with advantage in the earlier stages of the illness.

There are two circumstances which often tend greatly to interfere with the satisfactory progress of pneumonia—the pain in the side, and the cough. The former of these may usually be relieved by the application of large hot linseed poultices, or of hot fomentations, to the side. These must be frequently changed, and great care should be exercised in their renewal not to disturb or inconvenience the patient. If these means do not succeed, a small blister 2 by 2 inches, or three or four leeches, may be applied to the seat of the pain, and the hot applications then renewed. In exceptional cases small doses of morphine hypodermically may be necessary to relieve this symptom. The influence of the external application of cold will be alluded to subsequently. Cough is not usually a troublesome symptom, and, unless it greatly disturbs the patient, it is better not to interfere with it. If necessary, a linctus, containing from two to four minims of solution of hydrochlorate of morphine, with a similar quantity of spirit of chloroform, and ipecacuanha wine, given occasionally, is often beneficial. By means of the treatment above indicated, and by keeping the room quiet and darkened, the patient will often procure a sufficient amount of sleep. This can very frequently be promoted by carefully sponging the whole surface of the body, a portion at a time, with tepid or cold water, the last thing at night. Should it be necessary, some hypnotic must also be administered, but with great caution, so as not to interfere with freedom of expectoration; and it should only be had recourse to when other means have failed, and in the absence of contra-indications. Hyoscyamus and bromide of potassium may be safely used for this purpose; and, should these fail, opium may be given. This should be prescribed in a sufficiently large dose to ensure sleep, and is best administered hypodermically, as acetate of morphine. Chloral hydrate is usually contra-indicated, on account of its depressing effect upon the circulation.

A large number of cases of pneumonia terminate in health without the necessity of any further interference on the part of the physician than has been described. Frequently, on the other hand, circumstances arise indicative of danger, which require to be met by more active treatment. In those whose vitality is impaired by age, habits, or other causes, and in whom prognosis is less favourable, special care and watchfulness should be exercised in anticipation of any unfavourable symptoms. The chief source of danger, as already stated, is failure of cardiac power, and consequently all symptoms of such failure must be carefully watched for.

Any sign of cardiac failure will in the first place suggest the advisability of administering alcohol. The exhibition of small quantities of wine with food is sometimes useful in stimulating the appetite and assisting digestion, in cases where there are no symptoms of asthenia; but when such symptoms arise, alcohol must be employed in larger quantities. It may be stated generally that a pulse of over 120 calls for the employment of stimulants. Brandy appears in most cases to answer best. The amount administered must depend upon its effects; and although in most cases from four to eight ounces in the twenty-four hours will be sufficient, if the asthenia persist it must be given in much larger quantities. The disease is one of comparatively short duration, and there is perhaps no other acute illness in which the free exhibition of alcohol, when indicated, is more likely to be advantageous. Bark and ammonia are in some cases useful in addition to the alcohol; and digitalis in medium doses, as a means of maintaining the heart and circulation, is often of undoubted value.

In the treatment of failure of cardiac power, however, it is important to attempt to modify, as far as possible, those conditions upon which such failure principally depends. The most important of these probably is the pyrexia.

The remedies formerly employed with the object of diminishing pyrexia—aconite, tartar emetic, and veratrum—have such a depressing effect upon the heart and circulation that their use has long been abandoned. The recent antipyretics—antifebrin and antipyrin—are open to the same objection, and they occasionally cause so much prostration and collapse that they must certainly be regarded as dangerous remedies, and as requiring great caution in their employment. Although a much more extensive experience is necessary, at present the utility of these drugs in the treatment of pneumonia is extremely doubtful.

A remedy of much greater value than the preceding is quinine. In order, however, to produce any marked influence upon the pyrexia, this drug must be given in doses of from twenty to thirty grains; and inasmuch as even such large doses are rarely followed by a reduction in the temperature of more than 1° or 2° F., and are apt to cause nausea, vomiting, and other unfavourable symptoms, this method of using the drug is not generally to be recommended. It is in smaller doses of three to five grains that quinine is of undoubted use. Thus given three or four times in the twenty-four hours (perhaps best suspended in milk), it appears to steady the nervous system and sustain the patient, although it may have little or no influence upon the temperature chart.

A much more efficient means of diminishing the pyrexia than by internal remedies, is by the external application of cold. This reduces temperature, not only by abstracting heat, but also by stimulating the nervous centres concerned in the regulation and control of heat-production and heat-loss; and its adoption in some form is in most cases useful.

The treatment of pneumonia by the external application of cold has been much more extensively employed in Germany than in this country. The application of frequently renewed cold wet compresses to the chest was advocated by Niemeyer twenty years ago, who stated that in the majority of cases thus treated, pain, dyspnœa, and pyrexial symptoms were markedly relieved, and the duration of the disease was often shortened.

The use of the cold bath is advocated by Juergensen in the earlier stages of the disease, before the heart has become enfeebled; but the difficulties attending such treatment, and the prejudice against it are such, that much more conclusive evidence of its utility is necessary before its adoption is to be recommended in any except, perhaps, those quite exceptional cases in which the temperature reaches 106° or 107° F. (hyper-pyrexia).

Sponging the whole surface of the body with cold or tepid water has already been alluded to as a useful means of promoting sleep. This is an easy method of cooling the patient, and may often be practised several times a day with distinct advantage. Packing in a wet sheet—a much more efficient means—is often useful, especially in cases attended with prominent nervous symptoms.

The most recent method of treating pneumonia by cold is by the application of an ice-bag to the chest over the inflamed lung. This treatment, which has been tested especially by Dr. Lees, is not only a very efficient means of reducing the temperature, but it appears also to control the lung-inflammation. Dr. Lees says the treatment is usually pleasant to the patient; in the great majority of cases a remarkable improvement follows the application of the ice; a reduction of temperature usually occurs at once, often amounting to 3° or 4° F.; if a subsequent rise occurs it usually rapidly yields to a second application; and the improvement is not confined to a mere reduction of temperature, but in many cases there is an arrest in the development of the physical signs. The results obtained by Dr. Lees justify the hope that the ice-bag, used with proper precautions, may prove a valuable aid in the treatment of pneumonia; and it is certainly deserving of a more extended trial.

Although failure of cardiac power is the chief source of danger in pneumonia, dyspnœa is occasionally a most grave symptom, especially in those cases in which both lungs become extensively involved. This dyspnœa is due partly to the lung-consolidation, and partly to the pyrexia; hence it will be only partially relieved by anything which reduces the temperature. It has long been known that the dyspnœa of pneumonia is diminished temporarily by venesection, and at the present day this is probably the only symptom in this disease for the relief of which the practice of bleeding would be regarded as at all justifiable. In considering the advisability of removing blood in those cases in which dyspnœa constitutes an urgent symptom, it must, however, be borne in mind not only that the relief is merely temporary, but that the loss of blood must tend more or less to weaken the patient, and hence to favour that condition of asthenia which is of all things the most to be feared. Bleeding is certainly only to be thought of when the dyspnœa threatens life, and when at the same time the strength, as indicated by the pulse, is good; and it should not exceed the removal of eight or ten ounces of blood. Such cases are certainly not common.

Of the complications, delirium sometimes calls for treatment. Active delirium is not common in pneumonia, except in those who have been intemperate. When marked, it is always indicative of danger. In its management the practitioner must be guided by the general condition of the patient; but, speaking generally, it calls for the free exhibition of alcohol, and the external application of cold. Cold, applied in some of the ways already indicated, is of especial value in these cases, not only reducing the temperature, but quieting the patient and often producing refreshing sleep. The influence of an experienced nurse is all-important. In some cases it may be advisable to administer an opiate. This should only be done, however, as a last resource; and when there is marked asthenia it is unadvisable. The opiate should be given in one full dose sufficient to procure sleep. Morphine administered hypodermically is the best form of exhibiting it.

Of the management of other complications occurring in the course of pneumonia there is nothing special to be remarked; they must be treated on general principles. The existence of bronchial catarrh often requires small doses of ipecacuanha with carbonate of ammonium and salines. Diarrhœa and gastric symptoms are to be met by careful dieting, chalk, bismuth, and, if necessary, other astringent remedies. In pneumonia, as in other acute diseases, the administration of an opiate enema is an efficient and safe means of checking diarrhœa. Pericarditis rarely admits of any special interference.

Convalescence.—During the period which immediately succeeds the crisis, the utmost care is required to support the patient, and to prevent any serious amount of prostration, which at this time so often supervenes. Stimulants are usually required for some days after the temperature has attained the normal standard. Convalescence in most cases is quickly established. Solid diet is soon desired, and may be safely given. Tonics —such as quinine, iron, and cod-liver oil—and change of air are useful in assisting the restoration to health.

B. **Secondary Pneumonia.**—DEFINITION.—Secondary pneumonia is an inflammation of the lung occurring in those who are the subjects of some other disease; the pneumonic process standing in more or less causal relation to the disease in the course of which it supervenes.

Intercurrent pneumonia.—Before proceeding to consider secondary pneumonia as thus defined, we have to remark that ordinary pneumonia occasionally occurs in the course of other diseases as an *accidental* complication. Such pneumonias may be termed *intercurrent*, and they are to be distinguished from the secondary affections. They usually closely resemble, in their clinical features, the acute disease as it has been already described; although in some cases they are more or less modified by the disease in the course of which they supervene.

Hypostatic pneumonia.—There is also a class of consolidations of the lung very common in those who are the subjects of other diseases, which are often described as secondary pneumonias, though really for the most part non-inflammatory in their nature; but they may be conveniently alluded to in the present article. These are the consolidations so often met with at the bases and more dependent portions of the lungs, in the course of both chronic and acute diseases, and also in the aged. They have been termed *hypostatic pneumonias*, and consist, in the main, of collapse, hyperæmia, and œdema of the lung-tissue, resulting from weak inspiratory power, feeble circulation, and gravitation. The consolidation thus mechanically induced is increased by more or less exudation of liquor sanguinis and blood-corpuscles into the alveoli; which exudation is due to the damage to the walls of the capillaries caused by the blood-stasis. There is also some swelling and shedding of the alveolar epithelium.

ÆTIOLOGY.—Secondary pneumonias, as already stated, bear a causal relation to the disease in the course of which they supervene. They would seem to owe their origin almost exclusively to some abnormal condition which the pre-existing disease has induced. They occur in the course of many diseases, and sometimes appear to constitute the acute affection which determines dissolution. In Bright's disease they are the most frequent. Ordinary pneumonia may, however, occur in the course of Bright's disease.

ANATOMICAL CHARACTERS.—The changes occurring in the lung in secondary pneumonia are, for the most part, precisely similar to those of the acute primary disease. In many cases, however, the consolidation is less dense; and epithelial changes sometimes constitute a more prominent feature in the process. The pleura is usually implicated, but not so invariably so as in ordinary pneumonia. With regard to the situation of the consolidation, it is more frequently situated in the upper and middle lobes, and is more often double than is that of the primary disease.

SYMPTOMS.—The clinical phenomena of secondary pneumonia differ from those of the acute primary disease, the symptoms so characteristic of the latter being almost entirely wanting. The symptoms which do exist are often but little pronounced, and the disease may even run an almost latent course. This latency of symptoms is often partly due to their being masked and modified by those of the disease to which the pneumonia is secondary.

The onset of the pneumonic process is usually unattended by rigors or other marked phenomena. Cough, expectoration, pain, and dyspnœa are often slight, and they may indeed escape observation. If cough be present, the sputa may be free from blood, and simply watery or muco-purulent. The pyrexia is moderate, the temperature often not being more than 100° F. Not infrequently slightly increased frequency of the respiration, with occasional cough, and symptoms of increased illness, are all that exist to indicate that inflammation of the lungs has supervened.

DIAGNOSIS.—Owing to the frequent latency of the symptoms of secondary pneumonia, the diagnosis often rests, for the most part, upon the existence of physical signs of pulmonary consolidation. When the consolidation occupies the posterior and inferior portions of the lung, it may be impossible to distinguish it from simple hypostasis.

PROGNOSIS.—The supervention of secondary pneumonia in the course of a chronic disease usually, but by no means invariably, indicates that the disease will shortly terminate in death. The pulmonary inflammation appears to determine dissolution. Pneumonia occurring in acute diseases materially increases the gravity of the prognosis.

TREATMENT.—The treatment of secondary pneumonia usually resolves itself into that of the disease in the course of which it occurs. Warm applications to the chest, small doses of carbonate of ammonium, and alcoholic stimulants may sometimes favourably influence the pneumonic process.

C. Broncho-Pneumonia. — SYNON.: Catarrhal Pneumonia; Lobular Pneumonia; Fr. *Pneumonie Lobulaire*; *Broncho-pneumonie*; Ger. *Bronchopneumonie.*

DEFINITION. — Broncho-, catarrhal, or lobular pneumonia is inflammation of the lung-tissue, due to an irritant entering and spreading by the bronchi, which usually causes, in the first place, catarrh of the bronchial mucous membrane. This frequent association of the pulmonary inflammation with bronchial catarrh explains the terms *broncho-* and *catarrhal*, which are applied to this form of pneumonia. In the earlier stage the pulmonary inflammation is commonly limited to scattered groups of air-vesicles (*lobular*), but as the process advances, the inflammatory nodules may gradually coalesce so as to produce larger tracts of consolidation. The inflammatory products which fill the alveoli consist principally of cells, derived from the epithelium of the alveoli, and from the bronchial mucous membrane; exudation and emigration play a much less prominent part in the process than they do in ordinary pneumonia.

ÆTIOLOGY.—Broncho-pneumonia, as already stated, is generally associated with bronchial catarrh. In some cases it would appear that the irritant which produces the bronchial inflammation produces at the same time inflammation of the alveolar walls, but much more frequently the bronchitis precedes the pneumonia, and gives rise to it in a manner to be hereafter described. Whatever causes inflammation of the bronchial mucous membrane may thus be a cause of broncho-pneumonia.

Simple non-specific bronchitis is frequently followed by broncho-pneumonia, especially in childhood and in old age. All those conditions which favour the occurrence of such bronchitis must therefore be enumerated amongst the causes of this form of pneumonia. Of these conditions it will be sufficient to mention here the marked influence of cold and damp. It is, however, the specific forms of bronchitis, associated with measles, whooping-cough, diphtheria, variola, and influenza, which are the most liable to be followed by broncho-pneumonia. This is especially the case with that accompanying measles and whooping-cough. In both these diseases this form of lung-complication is exceedingly frequent.

Less frequent causes are dusts of various kinds—particles of earth, stone, steel, &c.; organisms, the most important of which is the bacillus of tubercle; and, lastly, putrid discharges from wounds or diseases of the pharynx, nose, or other parts of the passages. These various irritants may, by aspiration into the bronchi, give rise to bronchitis and broncho-pneumonia.

All conditions which tend to impair the general health and strength, favour the occurrence of broncho-pneumonia. The weakly and debilitated suffer most. Bad air and insufficient food are important predisposing causes. Depressed health not only weakens the resistance of the tissues, and thus favours the development and spread of inflammation, but also diminishes the power of the respiratory muscles, and thus aids in the production of pulmonary collapse, a condition which, as will be seen presently, is especially favourable to the pneumonic process. Owing to the general debility and weakness of the thoracic parietes in rickets, bronchitis in the subjects of this disease is exceedingly liable to be followed by broncho-pneumonia.

Broncho-pneumonia is most common during the first four years of life—the period when bronchial catarrh, measles, and whooping-cough are so frequent. It is also common in old age. In young adults it is comparatively rare. Sex has no influence.

Anatomical Characters.—The appearances presented by the lungs after death from broncho-pneumonia vary. The bronchi always exhibit signs of more or less bronchial catarrh. This may involve the whole of the bronchial mucous membrane, but it is usually most marked in the smaller tubes. These are found containing a thick, tenacious, and often puriform secretion, which is occasionally here and there drier or inspissated. The mucous membrane of these tubes is more or less softened, swollen, red, and thickened, and often presents irregular superficial erosions. Owing to this inflammatory swelling, the tubes stand out prominently on section of the lung. Cylindrical dilatations of the tubes are also frequently met with.

The lung-tissue itself exhibits, associated in various degrees, collapse, congestion, œdema, emphysema, and pneumonic consolidation. The bluish, non-crepitant, depressed portions of collapse, which become darker and more friable with age, are usually most abundant in the lower lobes and margins of the lungs. The collapse sometimes involves the whole of one lobe, but more commonly it is limited to much smaller areas of the lung. When scattered and limited in its distribution, there is usually more or less emphysema of the intervening portions of the lung; when collapse is very extensive in the lower lobes, emphysema is most marked in the upper.

Those portions of the lung in which the pneumonic process has supervened appear most commonly as scattered patches and nodules of consolidation, varying in size from a small pea to a hazel-nut. These are usually more or less conical in shape, with their bases towards the pleura, which membrane is generally unaffected over them, though it may be coated with lymph. On section, the patches are commonly ill-defined and pass insensibly into the surrounding tissue, which is variously altered by congestion, collapse, and emphysema. They are of a reddish-grey colour, slightly elevated, smooth, or faintly granular, and soft and friable in consistence. As they increase in size they may become confluent, and thus are produced large tracts of consolidation. In a more advanced stage, the nodular and more diffuse consolidation becomes paler, firmer, and drier, and resembles in colour the greyish-yellow hepatisation of acute pneumonia. The cut ends of dilated bronchi, filled with pus, are occasionally seen in the centres of the pneumonic nodules. When the pneumonic process is due to the aspiration of putrid particles, abscesses are found instead of these solid patches.

Microscopical characters. — When examined microscopically, this consolidation is seen to consist of an accumulation within the alveoli of a gelatinous mucoid-looking substance, small cells resembling leucocytes, epithelial elements, and red blood-corpuscles. In many cases much of this accumulation is precisely similar to that contained in the smaller bronchi; and it is evidently the inflammatory and richly cellular bronchial secretion which has been inhaled. At the same time, it is doubtless partly the result of exudation and emigration from the pulmonary capillaries; such exudation and emigration, however, do not play nearly such a prominent part in the process as they do in acute pneumonia, and a fibrinous coagulum is rarely met with. The epithelial elements are swollen and granular, and are probably the alveolar epithelium which has been shed. The relative proportion of epithelium and leucocytes varies considerably in different cases, probably owing to differences in the intensity of the inflammation, and to the degree in which the inhalation of the bronchial secretion constitutes a part of the process.

The subsequent changes which take place in the lungs vary. When the disease does not end in death, resolution is the most common termination. The contents of the alveoli undergo fatty degeneration, and are removed by expectoration and absorption, the lung gradually regaining its normal characters. This process, however, is less readily effected than in the consolidation of acute pneumonia; and it often occupies such a lengthened period, that some thickening of the bronchial and alveolar walls and dilatation of the smaller bronchi remain. In still more chronic cases the fibroid thickening is much more marked, and a considerable amount of irregularly distributed, pigmented induration and bronchial dilatation may be produced. In these chronic forms the contents of the alveoli sometimes caseate, and the caseous products become encapsuled.

Pathology. — The inflammation of the bronchial mucous membrane which is usually associated with broncho-pneumonia, in the great majority of cases precedes and is an important cause of the pneumonic process. In some cases it would appear probable that the same injury which produces the bronchial inflammation produces at the same time the inflammation of the air-vesicles. Inflammation of the bronchial mucous membrane may give rise to broncho-pneumonia in two ways: (1) by causing, in the first place, collapse of the lung-tissue; and (2) by the direct extension of the inflammation from the bronchi to the air-vesicles. The pneumonic process, being the result of the bronchitis, almost invariably involves both lungs.

(1) *Broncho-pneumonia consecutive to collapse.*—Collapse of the lung-tissue greatly favours the occurrence of broncho-pneumonia, and usually the pneumonic process is principally confined to those portions of the lung in which collapse has taken place. This is particularly the case in young children. Although it would be beyond the scope of the present article to discuss at length the relation which subsists between bronchial catarrh and pulmonary collapse, the mode of production of the latter may be briefly indicated. There are two circumstances principally concerned in the production of the collapse which is consecutive to bronchitis—the narrowing of the bronchial tubes, and the weakness of the inspiratory power. The mucous membrane of the bronchi becomes considerably swollen as the result of the inflammatory process, often being thrown into folds; and its surface is covered with thick tenacious mucus. These conditions may cause so much narrowing of the smaller tubes as to render the entrance of air exceedingly difficult, and they may even completely prevent it. In addition to the bronchial narrowing, the power of inflating the lungs is usually diminished. This is due partly to the general debility which so often exists prior to the bronchitis, and partly to the damage to the respiratory muscles caused by the febrile process. The superficial character of the respiration due to the fever also aids in the production of the collapse, as does also any weakness of the osseous structures of the thorax, such as exists in rickets. The collapse thus induced is especially frequent in the posterior and inferior portions of the lungs—those portions in which normally the inflation of the lung is the least complete. Commencing here, the process may gradually extend upwards till large areas of both lungs become involved. In other cases, owing to a more irregular distribution of the bronchial obstruction, the collapse is limited to small isolated portions of the lung. These portions vary in size from a hemp-seed to a walnut. They are commonly more or less wedge-shaped, with their apices towards the bronchus leading to the group of collapsed lobules; and the lung-tissue around them usually presents various degrees of congestion and emphysema.

The tendency of the pneumonic process to occur in the collapsed portions of the lung is due partly to the hyperæmia which is induced by the collapse, and partly to the irritation of inhaled bronchial secretion. Collapse of the lung-tissue invariably induces more or less congestion. This is owing to the absence of the expansion and contraction of the air-vesicles which normally aid the pulmonary circulation, and also to the impediment to the blood-flow resulting from imperfect aëration. Thus results more or less damage to the vessel-walls, and consequent escape of some of the constituents of the blood. The congestion is quickly followed by œdema, and the bluish-purple collapsed portions of the lung become deeper in colour, less resistant, and more friable in consistence.

Another circumstance which often appears to play a prominent part in the causation of the pneumonic process, is the presence within the alveoli of the inflammatory products of the bronchial mucous membrane. Such products are frequently found in the lungs in cases of broncho-pneumonia. They occur in scattered groups of air-vesicles, and are evidently inhaled. They are found both in the air-containing and in the collapsed portions of the lung, but especially in the latter, the presence of collapse necessarily interfering with their removal by expectoration or absorption. These inhaled products are often found filling small groups of alveoli without any evidence of subsequent inflammation, and there can be little doubt that many of the patches of consolidation which are usually described as pneumonic are in reality non-inflammatory in their nature, and are thus produced. At the same time, owing to the irritation of the inhaled secretion, it tends to induce inflammatory changes within the alveoli, and these changes are frequently largely owing to its presence. Juergensen accounts for the pneumonic process occurring in isolated spots in the collapsed lung by regarding the inflammation as being determined by the inhaled bronchial secretion.

(2) *Broncho-pneumonia independent of collapse.*—The pneumonic process may occur independently of collapse, being due solely to the spreading of the inflammation from the smaller bronchi to the air-vesicles. The irritation of substances inhaled into the alveoli may also be the sole cause of the pulmonary inflammation.

Symptoms.—The symptoms of broncho-pneumonia vary according to the rapidity with which the disease is developed, the extent of lung involved, and the nature of the disease in the course of which it supervenes.

The more severe and most common forms of the disease are met with in early childhood in association with simple bronchitis, and the specific bronchitis of measles and whooping-cough. In these cases the symptoms and dangers, are in the main, those of the capillary bronchitis which precedes the pneumonic process, and it is sometimes impossible to distinguish between them. Frequent cough, accelerated respiration, slight action of the nares, and other symptoms of severe bronchitis, with perhaps a little pyrexia, precede for a varying length of time the symptoms due to the implication of the lung-tissue. The earliest symptoms of the pneumonic process are by no means well-defined, and consequently the time at which the lung becomes involved cannot be fixed with certainty. Rigors, convulsion, and vomiting are but rarely observed. Usually an increase in the acceleration of the respiration or in the dyspnœa, and a marked rise of temperature, are the first signs of the pulmonary implication. The breathing becomes very rapid, and commonly causes much distress, the child tossing about and being exceedingly restless. This dyspnœa is more marked at some times than at others, and is occasionally more or less distinctly paroxysmal. The respiration is superficial, inspiration being short, and the expansion of the thorax imperfect. There is marked action of the accessory respiratory muscles, and the upper portions of the thorax are raised, whilst the lower and the soft parts are retracted during the inspiratory act. The action of the nares is very pronounced.

An increase in any pyrexia which attended the pre-existing bronchitis is, with few exceptions, observed as the lungs become involved, and such increase is to be regarded as one of the most valuable indications of the existence of a pneumonic process. The maximum temperature of acute simple bronchitis, even in the child, is seldom higher than 102° F., whereas that of the secondary pneumonic process is often 104° or 105°. This increase usually occurs more or less gradually; there is rarely the sudden rise of temperature met with in acute pneumonia. Unlike the temperature of this disease also, the fever of broncho-pneumonia runs no definite course. It varies with the extent of the lung-implication, and with the rapidity with which this implication is effected. There is no regular diurnal variation; the remissions and exacerbations are often considerable; and they occur at irregular times, the temperature being sometimes higher in the morning than at night. The cough, which before the implication of the lung was paroxysmal in character, gradually becomes less and less so, and it now often causes much pain to the patient. The sputa, when present, are bronchitic in character, usually tenacious, and occasionally streaked with blood; as, however, expectoration rarely occurs in the child, they are not often seen. The pulse is much increased in frequency, in children under five years often being 150. It may in the earliest stage of the disease be moderately full and strong, but it quickly becomes soft, small, and feeble. In addition to the above, there are often symptoms referable to the digestive organs. Of these diarrhœa is the most important. This is quite frequent, especially when the disease follows measles. It is very readily induced by medicines and by improper feeding; and as it greatly weakens the patient, it is important that this liability to diarrhœa should be kept in mind. Vomiting, as already stated, is very rare as an initial symptom; it is, however, common in the course of the disease, especially as a result of cough, the bronchial secretion, together with the contents of the stomach, often being expelled.

As the bronchitis and the implication of the lungs increase, the breathing becomes still more rapid and superficial; the dyspnœa is more marked; the expression is anxious; the face is pale; and symptoms of carbonic-acid poisoning become evident. Strength now fails; the face and lips become cyanotic; and the extreme restlessness gives place to apathy and a semi-comatose condition, which is interrupted from time to time by ineffectual efforts to cough. With the rapid failure of strength and increasing cyanosis, cough almost ceases; the pulse becomes exceedingly feeble; and the child, often extremely emaciated, may die exhausted, and in a condition of more or less profound coma. Sometimes death occurs suddenly during a paroxysm of cough, or with convulsions.

In those cases in which capillary bronchitis constitutes a less prominent feature of the illness, the symptoms are usually less severe—the pyrexia is less marked and its onset more gradual; the pneumonic process often supervenes later; and the course of the disease is more protracted. A slight and markedly irregular pyrexia, increasing difficulty of breathing, with loss of strength and flesh, may continue for months, and the child ultimately die, or recover with more or less damaged lungs. In these more chronic forms of the disease, which are perhaps most common after whooping-cough, the pneumonic process is often less disseminated, and involves larger areas of the lung—not infrequently a whole lobe. This is owing to bronchitis constituting a less, and pulmonary collapse a more, prominent element in the causation of the disease.

When broncho-pneumonia occurs in adults and in the aged, the symptoms are for the most part much less pronounced than in the child. In strong adults the disease is perhaps most common after diphtheria, and here the pulmonary symptoms may be well-marked; but in the debilitated, and especially in the old, the course of the disease is much more latent, very slight pyrexia (100° F.), slight cough and dyspnœa, and marked debility being the principal symptoms observable.

In the aged and feeble, broncho-pneumonia is frequently associated with that form of lung-consolidation which results from weak inspiratory power, feeble circulation, and gravitation; and which consists mainly of collapse, hyperæmia, and œdema of the lung-tissue (hypostatic pneumonia). This hypostatic consolidation may exist quite independently of bronchial catarrh; but when such catarrh occurs in the aged and feeble, gravitation often determines the supervention of the pneumonic process, which under such circumstances is consequently not infrequently unilateral.

When the more acute varieties of broncho-pneumonia terminate fatally, they usually do so from the tenth to the fourteenth day of the disease. Death, unlike that from acute pneumonia, is mainly due to the interference with the respiratory function, and, to a much less extent, to failure of cardiac power. The interference with the respiration is much greater than in acute pneumonia, for, in addition to the diminution of the respiratory area, due to the pulmonary consolidation and collapse, there is the much more important cause of interference—namely, the impediment to the entrance of air, caused by the swelling of the bronchial mucous membrane, and the accumulation of secretion in the bronchial tubes. These interferences with respiration necessitate increased action of the respiratory muscles; but with the progress of the disease these muscles become weakened, partly by the fever, and partly from the imperfect supply of oxygen. With this failure of respiratory power the incompleteness of oxygenation necessarily increases, until the supply of oxygen may become so small as to lead to complete muscular paralysis. The damage to the heart, as in acute pneumonia, is due partly to the diminished respiratory area, and partly to the fever; but this damage is a much less important element in the causation of dissolution in broncho-pneumonia, than it is in the acute disease. In the more chronic forms of broncho-pneumonia death may not occur for some months, and then it results as much from general failure of strength as from interference with the respiratory function.

When the disease does not terminate in death, improvement in the symptoms is always gradual. The temperature falls slowly, several days, and occasionally some weeks, being occupied in the completion of defervescence; and this gradual decline is usually interrupted by more or less marked and frequent exacerbations and remissions of the fever. The cough and dyspnœa diminish, and the appetite gradually returns; but restoration to health is always protracted; and the child remains for some time especially liable to repetition of the bronchial symptoms.

Sometimes recovery from the broncho-pneumonia is not complete, and the disease leads to induration of the lung, with dilatation of the bronchi. Emphysema and pulmonary tuberculosis are occasional sequelæ.

Physical signs.—The physical signs of broncho-pneumonia are in the main those of capillary bronchitis. Imperfect expansion of the thorax, elevation of the upper portions, and recession of the lower, during the inspiratory act; moist and dry *râles*, audible over both sides; and the absence of any marked alterations in percussion-resonance, are the principal signs observable, not only in the earlier stages, but throughout the whole course of the disease. The recession of the chest-walls is increased by collapse. The pulmonary implication is indicated rather by the symptoms—increase in the pyrexia and in the dyspnœa—than by any marked alteration in the physical signs. The difficulty of detecting the lung-consolidation is due to its usually being limited, in the earlier stages, at all events, to small areas, which are surrounded by healthy or emphysematous lung, so that resonance on percussion is but little impaired. It is only when these small areas have coalesced into larger areas of consolidation, that any marked alterations in percussion-resonance are discoverable. The impaired resonance due to collapse is not to be distinguished from that due to pneumonic consolidation; and, inasmuch as the collapse is so often symmetrical, involving both bases posteriorly, the difficulty of appreciating it is increased. Much more valuable aid in physical diagnosis is in most cases to be obtained from auscultation. Over those portions of the lung where consolidation has taken place, the moist bronchitic *râles* tend to assume a somewhat metallic quality; they also become finer, though not so fine as true pneumonic crepitation; and they are more superficial. The detection of these superficial, somewhat metallic fine moist *râles*, heard with inspiration, and not dispelled by cough, over small areas of the lungs, especially at the posterior bases, is a most valuable and often the only physical sign of the pulmonary implication. If larger areas become consolidated, there may be in addition some tubular breathing, and some impairment of resonance on percussion; and when a whole lobe is involved the physical signs become increasingly pronounced, and in the child a bronchophonic cry is often marked on auscultation.

Complications.—Pleurisy is less common than in acute pneumonia. Slight inflammation of the pleura is, however, usually found *post mortem* over those portions of the lung which are consolidated. Pleuritic effusion is rare. Intestinal catarrh is a very important and common complication. The liability to this in the child, and the mechanical congestion resulting from the obstructed pulmonary circulation, must be borne in mind in explaining its frequency.

Convulsions occasionally occur, and are of unfavourable augury. The nervous phenomena in some few cases have been described as simulating those of tubercular meningitis.

Catarrhal laryngitis, associated with much spasm and laryngeal stenosis, is sometimes observed, especially after measles.

Diagnosis.—The diagnosis of broncho-pneumonia is occasionally difficult. This difficulty is mainly owing to the co-existence of capillary bronchitis. The recognition of the pulmonary implication in its earlier stages is often impossible. The increased pyrexia and frequency of respiration are the symptoms of the most diagnostic value. Owing to the small areas of lung involved, any alteration in the physical signs of the capillary bronchitis may be entirely wanting. The occurrence of extensive collapse in the earlier stages gives more marked physical signs of consolidation, and hence renders the diagnosis more easy. It is almost impossible to diagnose certainly, either by symptoms or by physical signs, between the collapse and the pneumonic consolidation. This, however, is of but little practical importance, inasmuch as the collapse is usually associated with, and often the immediate precursor of, the pneumonic process.

The diagnosis of broncho-pneumonia from the pulmonary consolidation of acute pneumonia may occasionally be difficult in those cases of the former in which an extensive area of the lung has become consolidated. The history of the case, and especially the course of the pyrexia, will usually suffice to distinguish them.

The distinction from pulmonary tuberculosis sometimes presents much difficulty, as does also the recognition of tuberculosis and phthisis as an occasional result of the disease. A careful consideration of the earlier symptoms, and the existence or not of marked predisposition, are here most important. Slight and irregular pyrexia, existing before the supervention of lung-symptoms, is greatly in favour of tuberculosis. In some cases, however, the phenomena of these diseases are so analogous that a certain diagnosis is impossible.

Prognosis.—The two circumstances which have an especial influence upon prognosis in broncho-pneumonia are the age of the patient, and the general health. Before puberty, the younger the patient the graver the prognosis. In children under five years, the mortality is exceedingly great (probably about 20 per cent.) The disease is also especially fatal in weakly children, and in all those who are constitutionally feeble, or debilitated by previous illness. The existence of rickets materially increases the gravity of prognosis. The danger also increases greatly with the extent of lung involved, much more so than is the case in acute pneumonia. Of the value of the several symptoms as influencing prognosis, after the description which has been given of the disease and of the modes in which it tends to cause death, it is hardly necessary to speak further. Symptoms of imperfect aëration of the blood are those most to be feared.

Treatment.—In the treatment of broncho-pneumonia, it is important to bear in mind—first, that the disease is generally associated with, and is in the main induced by, bronchial catarrh, and by its so frequently attendant collapse; second, that its occurrence is especially favoured by everything that weakens the patient; and, third, that it tends to destroy life principally by interfering with the function of respiration, which interference necessarily increases with the consequent weakening of the respiratory power. Such being the facts, it is obvious that the main object of treatment will be, first, to control bronchial catarrh, and endeavour so to modify it as to prevent the occurrence of collapse; and, secondly, to support as much as possible the strength of the patient, with the object of preventing not only collapse, but also that increased interference with the function of respiration which results from weakening of the respiratory muscles.

It would be out of place in the present article to enter into a detailed description of the management of acute bronchitis (*see* Bronchi, Diseases of). It will be sufficient to indicate the more important means of controlling the disease, with especial reference to the prevention of the so frequently attendant collapse.

The patient should be kept in a warm room, the temperature of which should never be allowed to fall below 62° F. The room should be well, but carefully ventilated; and protection from draughts is important—much more so than in the treatment of acute pneumonia. It is also advisable to keep the air moist by means of a steam-kettle, as the exhalation of water from the lungs is thus diminished, and the bronchial secretion consequently rendered less tenacious, and more easily removed by cough. A little carbolic acid—1 in 60—may be added to the water. The diet, which must be regulated according to the age of the patient, should be nutritious and easily digestible, the importance of supporting the strength being kept in mind. When the disease follows measles, the liability to gastro-intestinal catarrh must not be forgotten. Small doses of ipecacuanha wine with salines, and a little carbonate of ammonium, should be administered frequently. The chest should be enveloped in lightly made linseed and mustard poultices; or, as it is all-important not to interfere with the respiratory movement, it is wiser in young children to use some stimulating liniment, and apply a jacket of cotton-wool covered with oil-silk. When the secretion in the tubes is abundant, its removal may be much aided by small doses of carbonate of ammonium. This may be either combined with the ipecacuanha and saline mixture, or given separately in a little milk. Senega, as an infusion, and chloride of ammonium may also be given with the same object. The last-named drug appears to have the effect not only of rendering the secretion less tenacious and more easily removable, but also of diminishing its formation. An occasional emetic dose of ipecacuanha often materially relieves the patient, when numerous *râles*, audible over the chest, and increased dyspnœa, indicate an accumulation of the secretion. The exhibition of opiates is obviously contra-indicated.

In the acute forms of the disease, so common in early life, much may be done by the external application of cold. This not only reduces the temperature, but appears to be especially valuable in increasing the depth and force of respiration, and thus in preventing the occurrence of collapse. Its utility has been strongly advocated by both Bartels and Ziemssen, who recommend the frequently renewed application of cold wet compresses to the chest. The use of tepid baths, with cold affusions, is a more efficient way of obtaining the same result. The child is placed in a bath of from 85° to 90° F., and, whilst immersed, the head, back, and chest are quickly sponged with cold water. This repeated occasionally, with due precautions, is often followed by reduction of temperature, a diminution in the frequency and an increase in the depth of the respirations, and other signs of improvement. The application of ice-bags or ice-poultices to the chest often yields good results. The effects produced by the cold require in all cases to be carefully watched, and any depression caused should be met by the timely exhibition of stimulants.

Whilst these various means are being employed, it is all-important to support the strength of the patient. Brandy is here most valuable, and it is to be remembered that children bear stimulation well. The brandy is best given in milk, or with yolk of egg, the quantity being proportioned to the age of the patient. An infant may begin with from five to ten drops every two or three hours. Under its influence the pulse usually improves, the respirations become less frequent, and the distress and cyanosis diminish. The administration of brandy is usually advisable before and during the treatment by cold. When prostration is extreme, or deglutition difficult, both the brandy and other nutriment may be administered by the rectum.

In the more chronic forms of bronchopneumonia these active methods of treatment are but rarely called for. Here attention to strength and nutrition is most important, and small doses of cod-liver oil in the later stages, even before the complete disappearance of the pyrexia, are often useful. When the disease leads to induration of the lungs and dilatation of the bronchi, the treatment resolves itself into that of chronic pneumonia. Convalescence, it must be remembered, is always slow, and there is a tendency to relapse. Great care is consequently requisite during this period. All causes of catarrh must be carefully guarded against; and the restoration to health assisted by nutritious diet, cod-liver oil, and preparations of iron. A change of air is especially valuable.

D. Chronic Pneumonia. — SYNON.: Chronic Inflammation of the Lungs; Cirrhosis of the Lung; Fr. *Pneumonie Interstitielle*; Ger. *Lungencirrhose.*

DEFINITION.—Chronic pneumonia is a comparatively rare disease, characterised by a gradual increase in the connective tissue of the lung, which leads to an induration of the pulmonary texture, and to progressive obliteration of the alveolar cavities. It is commonly associated with catarrh and dilatation of the bronchi, and often with ulceration of the bronchial walls, and excavation of the indurated lung. Cough, expectoration—often abundant, but varying with the bronchial catarrh—dyspnœa, gradual impairment of nutrition, and occasional accessions of slight pyrexia, are the most prominent clinical phenomena accompanying the disease, which runs an exceedingly chronic course, often subject to long periods of quiescence, but tending to terminate fatally in from five to fifteen years.

Chronic pneumonia is also known as *interstitial* pneumonia. In its most marked form it constitutes the disease which received from Corrigan the name of *cirrhosis.* The term 'fibroid phthisis,' which is sometimes applied to it, is altogether inapplicable.

ÆTIOLOGY AND PATHOLOGY.—It is doubtful if chronic pneumonia is ever a primary and independent disease. It probably in all cases owes its origin to some more acute inflammation of the pulmonary or bronchial textures, or of the pleura, although cases are sometimes met with in which no history of any such antecedent affection is discoverable. It may be stated generally that all inflammatory processes in the lungs, as in other organs, which become chronic, lead to an increase of the connective-tissue elements, and consequently to fibroid induration of the organ. In the lungs by far the most common cause of such induration is chronic pulmonary tuberculosis. In all cases of phthisis, excepting those which are the most acute, there is more or less fibroid growth; and the extent of this growth is, for the most part, in direct proportion to the chronicity of the disease. Those forms of phthisis which are the most chronic, and in which the fibrosis reaches its maximum, have been termed 'fibroid phthisis.' The most chronic cases of phthisis are, it must be admitted, somewhat closely allied to some forms of chronic pneumonia. The two diseases, however, differ pathologically in this respect—that, whereas much of the pulmonary consolidation of phthisis tends to undergo molecular death and caseation, that of chronic pneumonia exhibits no such tendency; but any destruction and excavation of the indurated lung which may take place is due to secondary inflammation and ulceration commencing in the bronchial walls. In considering the pathology of chronic pneumonia, therefore, it is necessary to exclude in the first place the pulmonary fibrosis of phthisis. Chronic pneumonia must also be separated from that form of pulmonary induration which is produced by long-continued mechanical congestion—'brown induration;' and from those more localised indurations due to peri-bronchitis, old infarctions, syphilis, and atelectasis.

There appear to be four conditions which may give rise to chronic pneumonia, namely: (1) *Acute pneumonia*; (2) *Broncho-pneumonia*; (3) *Pleurisy*; and (4) *the inhalation of irritating particles of solid matter.* Each of these must be considered separately.

(1) *Acute pneumonia.*—Chronic pneumonia is an occasional, though very rare, result of the acute primary disease. The pulmonary consolidation of acute pneumonia almost invariably undergoes complete resolution. This resolution is usually effected rapidly, in from seven to fourteen days. Occasionally, however, the course of the disease is more protracted, and the consolidation persists beyond the third week. When thus protracted, the hepatised lung tends to become slightly indurated, owing mainly to thickening of the walls of the alveoli. This indurated hepatisation differs but little in its physical characters from ordinary red and grey hepatisation; it is simply somewhat firmer and more resistant. In very exceptional cases this small amount of induration commencing in the alveolar walls may gradually increase, so as ultimately to give rise to that extensive fibrosis of the lung which constitutes what is usually known as chronic pneumonia.

(2) *Broncho-pneumonia.*—Broncho-pneumonia appears to be a somewhat more frequent cause of the disease than the preceding (Wilson Fox). The greater liability of this form of pneumonia to lead to pulmonary induration is to be accounted for partly by its longer duration and greater tendency to become chronic, and partly by the existence of bronchial dilatation with which it is so frequently associated. That bronchial dilatation is favourable to an indurative pneumonic process has been especially insisted upon by the late Wilson Fox. Dilatation of the bronchi is exceedingly common in the simple and specific bronchitis of childhood, and especially in that associated with whooping-cough; it is also a direct result of pulmonary fibrosis. In whatever way originating, its existence favours the persistence of the catarrhal and pneumonic processes. The removal of secretion is rendered more difficult; the retained secretion tends to increase and keep up the irritative process, both in the dilated bronchi and also in the pulmonary alveoli; and this persistence of the bronchial and pulmonary inflammation leads to fibroid thickening of the bronchial and alveolar walls. In this way more or less disseminated patches of indurative consolidation are produced, which as the process goes on gradually increase, so that ultimately they may involve large areas of the lung. The progressive tendency of the process is probably partly to be explained by the fact, already stated, that pulmonary fibrosis is a cause of bronchial dilatation, so that fibrosis once established, by inducing further dilatation of the bronchi, favours the extension of the bronchial and pulmonary inflammation.

(3) *Pleurisy.*—Pleurisy in exceptional cases leads to the development of a chronic pneumonia. It appears to be in those cases of pleurisy which are more or less chronic, and in which the lung remains long collapsed from the effusion, that such a result is most liable to occur. The induration of the lung thus induced is sometimes, however, exceedingly partial, consisting merely in some increase of the interlobular connective tissue originating and extending inwards as dense bands from the thickened visceral pleura. In other cases pleurisy gives rise to a much more general fibrosis.

(4) *Inhalation of solid irritating particles.* This, which occurs in miners, potters, stonemasons, grinders, &c., is the cause of the fibrosis of the lungs so common amongst persons so employed. The continuous irritation of the inhaled particles induces a bronchial and alveolar inflammation, and ultimately a progressive fibrosis, which, gradually extending, may involve large areas or even the whole of the lungs. These cases sometimes become tuberculous.

ANATOMICAL CHARACTERS.—The histological changes met with in the lungs in chronic pneumonia may be described generally as consisting in the development of a fibronucleated tissue from the walls of the alveoli, from those of the bronchi, and from the interlobular connective tissue; which new-growth, as it increases, and from its tendency to contract, gradually replaces and obliterates the alveolar structure. The character of these changes, however, varies somewhat according to the more acute inflammatory antecedents in which they originate. When the result of acute pneumonia, the primary, and usually the principal, change takes place in the walls of the alveoli, although ultimately the interlobular tissue is involved. The alveolar walls become thickened by the growth of a small-celled tissue, which presents all the appearances found in embryonic tissue which is undergoing fibroid development. This new-growth, in its earlier stages, usually contains new blood-vessels; but later the tissue contracts, and the vessels become to a great extent obliterated. The alveolar cavities which are not obliterated are either empty, or contain exudation-products and a few epithelial cells.

When secondary to ordinary broncho-pneumonia, or to that induced by the inhalation of solid irritating particles, the new fibroid growth also originates principally from the alveolar walls. Here, however, in the earlier stages it is less uniform, and the peri-bronchial and interlobular connective tissues play a more prominent part in the process. The new peri-bronchial tissue invades the walls of the adjacent alveoli, and materially increases the fibrosis.

In the chronic pneumonia resulting from pleurisy, the change, as already stated, is sometimes more localised, consisting in the development of dense fibrous bands passing inwards from the thickened pleura. These are developed from the interlobular tissue. In other cases the fibrosis is more general.

In whichever of the pulmonary structures the new fibroid growth originates, all the connective tissue of the lung may become involved, as it increases, and the alveolar cavities may be completely obliterated. The new-growth, like that met with in the inflammatory indurations of other organs, although in the earlier stages of its development it may be richly cellular and contain new blood-vessels, tends gradually to become less cellular, denser, and more contractile. In its more advanced state it often consists either of closely packed wavy fibres, or more frequently of a dense homogeneous or obscurely fibrillated material, associated with which are a few small round or fusiform cells. Sometimes the new-growth is found richly cellular, even in the most advanced stages of the disease.

The macroscopical appearances of the lung vary with the extent of the fibroid change. In the earliest stages of the induration resulting from acute pneumonia, where there is merely a slight thickening of the walls of the alveoli, the consolidation very much resembles that of red or grey hepatisation. It differs in being firmer and less friable in consistence, and is somewhat less granular. In the later stages, and in all cases where the fibrosis is extensive and general, the appearances presented by the lung are very characteristic. The organ is diminished in size, dense, firm, fibrous, in parts almost cartilaginous in consistence. The cut surface is smooth; and the large amount of irregularly distributed black pigment usually present gives to it a peculiar grey, marbled appearance. Numerous dilated bronchi traverse it in all directions.

The bronchi are almost invariably found dilated in those portions of the lung where the induration is advanced. This dilatation is often very considerable, the dilated tubes forming cavities, which may occupy a large portion of the indurated lung. The walls of the tubes are much thickened, and the mucous membrane is often ulcerated. This secondary inflammation and ulceration of the bronchi, which occurs especially in the dilated portions, is induced by the irritating and often putrid secretion which they contain. It may extend into and involve the indurated lung, and so lead to more or less excavation. The mucous membrane sometimes sloughs, and the gangrenous process may involve the lung. The large cavities so common in these lungs are in the main, however, dilated bronchi. *See* Bronchi, Diseases of.

The pleura of the affected lung, except in the earliest stages of the disease, is much thickened and adherent.

Site.—Chronic pneumonia is in the majority of cases unilateral. The whole lung may be involved or only a portion. In the latter case the base is much more commonly affected than the apex. When it is due to the inhalation of irritating solid particles, both lungs are usually implicated.

Symptoms.—In the earlier stages of chronic pneumonia the symptoms are often very obscure, and it is not uncommon to meet with advanced and extensive fibrosis in which the lung-affection must presumably have been of much longer duration than the symptoms accompanying it. In some few cases the symptoms are directly continuous with those of some more acute pulmonary inflammation—an acute or a broncho pneumonia. Under these circumstances, a prolongation of some of the phenomena of the original disease indicates the supervention of the pulmonary fibrosis. The pyrexia does not entirely disappear. There may be merely slight elevation of temperature towards evening, or the course of the fever may be very irregular. The cough usually persists, as does also some increase in the frequency of the respiration and pulse; and the patient, instead of improving, gradually loses strength and flesh. At the same time the physical signs of the pulmonary consolidation remain, and gradually give place to those of pulmonary induration. Where chronic pneumonia is secondary to pleurisy, a continuous sequence in the symptoms is even less commonly observed. When it is the result of the inhalation of irritating solid particles, the symptoms of bronchial catarrh are predominant.

When the fibrosis is fully established the symptoms are usually more pronounced. They vary considerably, however, with the extent of lung involved, the situation of the consolidation, and especially according to the presence or absence of bronchial catarrh. When bronchial catarrh is absent, and the disease is quiescent, a considerable area, or even the whole of the lung, may be involved without producing any marked pulmonary symptoms; and slight dyspnœa and cough, with some general impairment of nutrition and failure of strength, may be almost the only phenomena present. Such quiescence and immunity from symptoms, however, although common in the course of the disease, is rarely observed over lengthened periods.

With the existence of catarrh of the bronchi, much more marked pulmonary symptoms are usually observable. Inflammation of the bronchi is especially favoured by their dilatation, and it is almost invariably present, to a greater or less extent, during the course of the disease. With it is usually associated activity of the indurating process. This dilatation of the bronchi, and secondary inflammation and ulceration of their walls, are most important factors in accounting for the symptoms. The course of the disease now often simulates that of chronic phthisis, but it is for the most part more chronic, less regularly progressive, and more frequently interrupted by periods of quiescence. The dyspnœa is now more marked, and cough becomes a troublesome symptom. The cough may be more or less constant, and it is usually attended by expectoration. Its characters vary, however, according to the situation and the extent of bronchial dilatation. When, as is most frequent, the lower lobe of the lung is involved, the secretion accumulates, and its removal by expectoration becomes exceedingly difficult. Under these circumstances the cough is often violent and paroxysmal. The patient may remain for several hours with but little or no cough, and then occurs a violent paroxysm, which results in the expectoration of large quantities of muco-purulent secretion. This violent paroxysmal cough and copious expectoration, occurring at long intervals, are exceedingly characteristic of bronchial dilatation in the lower portion of a lung. According to Niemeyer, the paroxysm occurs when the secretion which accumulates in the lower portions of the lung reaches and irritates the more healthy bronchi which retain their sensibility, the dilated tubes being so altered as to be completely insensible. The sputum may be simply puriform, but when there is much bronchial dilatation, owing to its accumulation and retention in the tubes, it often undergoes putrefaction, is of a greyish or greenish-black colour, and more or less fœtid. This putrid secretion not only intensifies the inflammation in the bronchiectatic cavities where it originates, but is often conveyed by aspiration to other parts of the same, or the opposite lung, and so originates foci of broncho-pneumonia, which materially hasten the progress of the disease. Hæmoptysis is not infrequent, but it is usually small in quantity, and is in most cases due to ulceration of the bronchial walls.

Pyrexia is usually present to a greater or less extent in the course of chronic pneumonia. The fever, however, is exceedingly irregular, and there are often long periods of perfect immunity. During the pyrexial periods the maximum evening temperature is rarely more than 101° or 102° F., and it may be only 100°. The morning temperature is often normal. The pyrexia appears in most cases to be due to inflammation and ulceration of the bronchi. It is not infrequently the result of a supervening tuberculosis.

With the progress of the disease the patient gradually emaciates; the fingers become clubbed; digestion is impaired, and diarrhœa is often present. Dropsy is a common symptom, although it is rarely extensive, and is, for the most part, confined to the lower extremities. It appears in most cases to be due to the anæmia and impeded pulmonary circulation. The pulmonary obstruction may also give rise to some enlargement of the right side of the heart, and cyanosis. Lardaceous disease of the viscera is occasionally met with. Death usually results from the general failure of strength, or from some intercurrent affection of the opposite lung.

Physical signs.—In the earliest stage of chronic pneumonia, when it is the result of a more acute pneumonic process, the physical signs are, in the main, those met with during the acute consolidation. It is the persistence of the signs of the pulmonary consolidation after the acute attack which indicates the possibility that the disease may become chronic. Dulness on percussion; increased vocal fremitus; bronchial breathing; and the existence of *râles*, which are larger, moister, and more metallic in quality than those of fine crepitation, are observable during this stage. When the induration is fully established, the physical signs are those of contraction and consolidation, with usually those of more or less dilatation of the bronchi, of a whole or a portion of the lung. The retraction is well-marked, and commonly affects the whole side, although when the lung is not universally involved it may be more limited. Expansion is exceedingly deficient, or completely absent. The heart is much displaced towards the affected side; the diaphragm and the abdominal viscera are drawn up; and the opposite lung encroaches considerably across the middle line in front. Percussion is hard, wooden, and high-pitched, sometimes more or less amphoric. The vocal fremitus is usually increased; and there is often bronchophony or pectoriloquy. The respiratory sounds will vary according to the extent of the bronchial dilatation and excavation, and the amount of secretion. They are for the most part bronchial; usually large and loud; and often distinctly cavernous. When there is much secretion in the dilated bronchi, high-pitched bubbling *râles* are heard, which are often amphoric and cavernous. These may be audible only after cough. The opposite lung is usually enlarged, hyper-resonant, and the respiration exaggerated.

Diagnosis.—The diagnosis of chronic pneumonia rests mainly on the physical signs. The diseases with which it is most liable to be confounded are chronic (tuberculous) phthisis, and retraction from pleurisy. In the most chronic forms of phthisis, where the fibrosis of the lung is considerable, the diagnosis from non-tuberculous consolidation may present some difficulty. This difficulty, however, rarely exists except in those quite exceptional cases in which the chronic pneumonia involves only the upper portions of the lung. Here the situation of the consolidation is very greatly in favour of its tuberculous nature. This probability is infinitely increased if the other lung be affected. In unilateral basic disease, and in induration of the whole of one lung, the other lung being healthy, the tuberculous nature of the disease is much less probable; although the occasional supervention of a tuberculosis in these cases should be borne in mind. An examination of the sputum for the bacillus of tubercle is usually the only means of settling the diagnosis. Disease of the larynx is in favour of the tuberculous, fœtidity of the sputa of the non-tuberculous, nature of the consolidation.

The retraction resulting from chronic pleurisy may also be confounded with chronic pneumonia. Here, however, there are rarely physical signs of dilatation of the bronchi, respiration is weak and distant, and the vocal fremitus is diminished. The presence of abundant fœtid sputa, of pyrexia, emaciation, &c., in chronic pneumonia will also in most cases render the diagnosis easy.

Prognosis.—Chronic pneumonia, when it involves a considerable area of the lung, usually tends ultimately to terminate in death, although under favourable circumstances life may be prolonged for many years. When the disease is limited, and remains quiescent, the general health and duration of life may sometimes be but little affected. The most important element in the prognosis is the condition of the bronchi. The existence of bronchial dilatation, as evidenced by profuse, and often fœtid, expectoration, is always unfavourable, as it not only weakens the patient, but is usually attended by extension of the induration, and ultimately leads, in the dilated tubes, to ulceration of the bronchial walls and surrounding tissue, and occasionally to gangrene. Pyrexia, as another evidence of inflammation of the bronchi and indurated lung, is likewise unfavourable, as is also hæmoptysis. The latter indicates deep ulceration, and it may in exceptional cases endanger life. The general condition of the patient must also be taken into account in making a prognosis. Failure of strength and of digestive power, diarrhœa, and dropsy, are all of unfavourable augury.

Treatment.—In considering the treatment of chronic pneumonia, it is in the first place important to bear in mind that the usual origin of tho disease is some more acute pulmonary inflammation. Hence the necessity for the most careful management and supervision of such inflammations in their later stages, with the object of procuring, if possible, a complete resolution of the pneumonic products.

When the fibrosis of the lung is established, it is hardly necessary to remark that the new-growth is incapable of removal, and by treatment we can only hope to influence the extension of the disease, and control the bronchial catarrh with which it is so frequently associated. The frequency and gravity of bronchial catarrh has been already insisted upon; and its management, in the majority of cases, constitutes by far the most important element in the treatment. Our object must be to prevent and control it; to promote expectoration, and to prevent that decomposition of the secretion which is so apt to result from its retention. Here the question of climate will necessarily present itself, and very much may usually be done by residence at some suitable station. One not subject to vicissitudes of temperature, and at the same time dry and moderately bracing, is most likely to be beneficial. The patient should be warmly clad, and everything should be done, by means of diet and medicine, to improve the general health, inasmuch as the better the state of nutrition, the less is the liability to bronchial inflammation. Cod-liver oil and iron are often useful for this purpose. If an attack of acute bronchial catarrh supervenes, it should be treated at once, and the importance of quickly controlling it should not be forgotten.

In the treatment of the more chronic catarrhal process which is so often associated with profuse secretion, much may usually be gained by the use of stimulating and antiseptic inhalations, of which creasote, eucalyptus, and carbolic acid are, perhaps, the most generally useful. These not only tend to diminish the amount of secretion, and to prevent its putrefaction, but induce coughing, and so assist in its evacuation. These substances may be administered internally with the same object. Counter-irritation, especially painting with iodine, appears sometimes to be serviceable. Gastric disturbance, diarrhœa, hæmoptysis, &c., must be treated, as they arise, on general principles.

In cases of localised basic disease, when other treatment fails, the question of paracentesis and artificial drainage of a large bronchiectatic cavity might be entertained.

T. Henry Green.

LUNGS, Inflation of.—This term is used somewhat ambiguously. It is sometimes employed as synonymous with emphysema in its general sense. More correctly it has been limited to that condition in which the lungs are acutely and temporarily distended more or less with air, as from plugging of the bronchial tubes in some cases of bronchitis, a condition which is usually called 'acute emphysema.' It cannot be said to give rise in itself to any definite symptoms; but it can be made out by physical examination, the signs being those indicating excess of air in, and consequent distension of, the lungs.

When this condition exists, the aim in treatment should be to get rid of any obstruction leading to the imprisonment of the air, and to help the lungs in expelling it. It must be remembered that, even after a considerable degree of distension, the lungs may be able to return to their normal dimensions.

'Inflation' is also a term applied to intentional expansion of the lungs with air, as carried out in certain methods of artificial respiration.

FREDERICK T. ROBERTS.

LUNGS, Malformations of.—There are no malformations of the lungs which can be regarded as of much importance from a clinical point of view. As anatomical peculiarities, the shape of these organs, or the arrangement of their lobes, may be abnormal. In a case which came under the notice of the writer, one of the lungs was improperly developed and unexpanded, in connexion with the almost complete absence of one of the divisions of the pulmonary artery. The form of the lungs is frequently more or less altered as the result of various organic diseases of these organs.

FREDERICK T. ROBERTS.

LUNGS, Malignant Disease of.—SYNON.: Fr. *Carcinome du Poumon*; Ger. *Lungenkrebs.*

DEFINITION.—Malignant disease affecting the pulmonary tissues.

ÆTIOLOGY.—Malignant disease of the lungs is of more frequent occurrence than was at one time supposed; but there are not sufficient trustworthy statistics to enable us to determine its relative frequency to other forms of thoracic organic disease. It has been met with in persons of all ages, from childhood to extreme old age; but the middle periods of life, from 20 to 60, are the most liable; and the two sexes are about equally obnoxious to the disease. As a primary disease, originating in the lungs, cancer is undoubtedly rare, though much less rare as first manifesting its presence in these organs, either by local or general symptoms. In by far the larger number of cases the disease in the lungs is secondary to cancer in other parts; and in this way, with the exception of the liver, the lungs are more frequently implicated than any other internal organ. Thus, after the removal of an external cancer, pulmonary symptoms are among the most frequent and earliest indications that the disease has invaded internal organs.

ANATOMICAL CHARACTERS.—The right lung has been considered to be more frequently affected with malignant disease than the left. This, however, does not accord with the writer's experience. Of thirty-nine cases tabulated by him, the left lung was the principal seat in fourteen, and the right in nine only, whilst of the remainder either both lungs were affected, or the disease was confined to the mediastinum. Of the several varieties of cancer, encephaloid is by far the most common in the lungs; colloid and epithelioma are the rarest; and scirrhus holds a middle place. The intermediate varieties of these leading forms are also occasionally seen.

SYMPTOMS AND DIAGNOSIS.—In proceeding now to describe the various aspects under which these several varieties are presented to the clinical observer, their natural history, and diagnosis, it is not proposed to maintain any precise distinction between primary and secondary forms, nor to discuss the minute anatomy or general pathology of the several species, such questions having been considered in other parts of this work. The object of the writer is to treat the subject from a clinical point of view. It is important, however, to observe, *in limine*, that cancer may either commence in, or eventually implicate, any or all of the pulmonary textures; although undoubtedly both the primary localisation and the spread of the disease are influenced by the particular species. Both the early symptoms and the subsequent progress of the case will often be materially modified by the particular tissue that is mainly implicated. If the disease first manifests itself in the form of subpleural growths, both the early symptoms and the subsequent phenomena will differ from those which present themselves when the disease commences in the deeper tissues of the lungs. And it is observable that, when the disease commences as disseminated deposits in the lungs, these deposits are frequently most numerous in the vicinity of the pleura, so that this membrane is very early implicated, in many cases, when it is not the primary seat of disease.

For clinical purposes we cannot do better than divide intra-thoracic cancerous growths into three groups: 1. Where the disease is *disseminated* through the lungs, either in the form of isolated scattered nodules of varying magnitude, or as spreading along the mucous membrane and sides of the bronchial tubes and vessels, through a greater or less extent of the lung. 2. Where the growth is more *localised*, occurring, for the most part, in large masses. 3. *Mediastinal tumours*, involving the various structures at the root of the lungs, and eventually giving rise to symptoms of pressure and distress of a more or less serious character.

1. **Disseminated Malignant Disease.**—In the disseminated form of pulmonary cancer the symptoms vary considerably, according to the seat of the growths. When the pleural surface is chiefly implicated, both the symptoms and the physical signs are essentially those of pleurisy, though the degree of febrile disturbance is usually very slight, and but little or perhaps no false membrane may be effused. But the more prominent symptoms are sometimes singularly localised even when the pleural surface is extensively implicated. The exudation is generally clear serum, or serum mixed with blood; and it may have a greenish or brown colour, but is rarely purulent or even semipurulent. As the effusion increases in amount, the ordinary consequences of compression of the lung ensue, but dilatation of the side is generally much less marked than in simple pleurisy with effusion, in consequence of there being less giving way of the intercostals. The fluid generally returns speedily after paracentesis.

When the mucous and submucous membranes of the bronchi and the surrounding connective tissue are the chief seats of the disease, the physical signs are those of bronchial irritation and emphysema, which, however, may, for some time, be quite disproportionate to the dyspnœa and other symptoms of ordinary bronchitis. The expectoration is, for the most part, scanty, and either simply mucous or mixed with blood; or small bronchial casts may be expectorated. Examination with the microscope will occasionally reveal characteristic cancer-cells, and the absence of tubercle bacilli may decide, in an otherwise doubtful case, that it is not phthisis. The resonance of the chest may remain normal, when auscultation proves that there is a diminution of air entering the lung. But there will not be the hyper-resonance of emphysema. Wheezing and dry and moist sounds vary much with the amount of constriction of the tubes, and the amount and character of the secretion. But in advanced cases of this kind, by the spread of the disease along the interlobular septa and through the lung, its condition becomes similar to that of a cirrhotic lung, and the clinical aspects of the case may be greatly altered. Perhaps the most characteristic symptom of this class of cases is dyspnœa insidiously increasing, especially on exertion, without corresponding symptoms of either congestion of lung or compression. Of the general symptoms, the most characteristic is that of steadily advancing debility, which is common to other forms of cancer. And it is from asthenia, or from general cachexia, that the patient usually dies, before much or any disintegration of tissue takes place. It is the scirrhous variety of cancer which most often thus follows and implicates the bronchi.

In the disseminated form, characterised by numerous masses, varying from the size of a millet-seed to that of a pea, scattered throughout the lungs, the clinical phenomena, both local and general, may very closely simulate those of tubercle, with recurrent attacks of bronchial irritation and congestion, and febrile disturbance. But as a rule, to which, however, some remarkable exceptions have been met with, there is little, if any, increase of temperature, nor is there the quickened breath and frequent dry cough of tubercle. The dyspnœa is chiefly on exertion, and seems more due to feeble circulation and general debility than to either pulmonary disease or febrile disturbance. Indeed, the absence of local signs of inflammation, or symptoms of functional disturbance, is frequently remarkable. Signs of bronchial irritation in some of these cases have been early noted and prominent symptoms; in other cases they have been slight and variable. The apices of the lungs, though often implicated, are not specially and early invaded as in tubercle, but rather the bases. If the cancerous growths are rapidly developed and extensively distributed through the lungs, both the signs and general symptoms become greatly modified, and the case proves speedily fatal. The similarity to acute tuberculosis is sometimes very close, especially in those instances in which there is marked febrile disturbance, and recurring slight hæmoptysis.

2. **Localised Malignant Disease.**—The second class of cases of malignant disease of the lungs, in which the disease manifests itself in the form of isolated masses of larger size, is the most common. There may be one such tumour or several, at first assuming a rounded form, but, as they gradually invade the lung, acquiring an indefinite shape, and involving a large portion or even the whole of the lung. Such tumours, being most frequently of the encephaloid varieties of malignant disease, often grow rapidly, and as rapidly disintegrate, giving rise to hæmorrhage and destruction, not only of the mass itself, but also of the surrounding tissues. In this way vomicæ may be formed, or portions of lung may become gangrenous.

The symptoms and progress of these cases necessarily vary much. If the growth or growths have attained any considerable size, there is dulness on percussion, and an absence of respiratory murmur over the affected portion of lung. The presence and character of other physical signs depend very much on the patency or occlusion of the bronchi. When, as is often the case, these are completely occluded, nothing whatever may be detected on auscultation, and all vocal fremitus may be absent; the implicated portion being completely shut off from the rest of the lung, and from all communication with the trachea. If, however, the bronchi remain patent, or—as the result of breaking down of the cancerous mass—if communication with the larger bronchi has been re-established, we have evidence of abundant secretion, and the ordinary phenomena associated with a cavity. In such circumstances microscopic examination of the expectorated matters may give decisive evidence of the nature of the case. On the other hand, before any such consequences have arisen, we may have in the case of a large tumour involving the whole or the greater part of one lung auscultatory signs which are with difficulty distinguishable from those of extensive pleuritic effusion. In other instances, where the portion of lung implicated in the cancerous growth is limited and well-defined, the physical signs may so closely resemble those of phthisis as to lead astray the most expert. Thus we may have limited dulness on percussion, with absence of respiration; followed by signs of surrounding irritation, slight hæmoptysis, cough, expectoration, and indications of a cavity. In some rare instances there have been limited flattening and altered form of the chest-walls, such as characterise chronic phthisis. Copious hæmoptysis, except in connexion with extensive destruction of lung-tissue, is not common in cancer of the lung. But there may be extensive sanguineous effusion into the pleural cavity, increasing the difficulty of diagnosis. The diagnosis in those instances, where the local signs closely resemble phthisis, must be based mainly on the constitutional symptoms and the history of the case, together with careful microscopic examination of the sputa.

There is considerable difference as to the progress and mode of termination in the whole of the class of cases now under consideration. Long before the local changes have advanced far enough to admit of a decisive diagnosis, the patient may die from rapidly increasing debility and emaciation, with more or less of hectic fever, and even typhoid phenomena; or he may be carried off by rapidly occurring pleuritic effusion. In other instances, cancer developing in other organs is the cause of death. Indeed, in a large proportion of cases the manifestation of malignant growths in the neck, the axilla, or other parts, places beyond question the nature of the case. So long as the growth is confined to the substance of the lung, and does not implicate the nerve-trunks and larger vessels, there is usually little pain, paroxysmal dyspnœa, or disturbance of the heart's action, excepting such as may be due to feebleness of muscular power. Nor is there generally any external œdema, or distension of the superficial veins. The reverse of all this characterises the cases in which the mediastinum and the roots of the lungs become involved.

3. **Mediastinal Tumours.**—This form of malignant disease of the lungs is described under a separate heading. *See* MEDIASTINUM, Diseases of.

PROGNOSIS AND TREATMENT.—The subject of the prognosis and treatment of malignant disease of the lungs in its various forms will be more conveniently discussed in the article MEDIASTINUM, Diseases of.

J. RISDON BENNETT.

LUNGS, Malpositions of.—Among malpositions may be regarded those conditions in which the lung is contracted more or less within its normal limits; or, on the other hand, distended so as to pass beyond its usual boundaries. One or both organs may be thus affected. These alterations may result either from more or less diminution of the amount of air in the lungs, as in cases of compression or collapse; from excess of the same, as in emphysema and hypertrophy; or from diseases which affect their structure. The lung may also be displaced by the pressure of tumours, in addition to being compressed. The most important malposition of the lung, however, is that known as *hernia*, in which a portion of the organ projects into the neck, or through some part of the chest-walls, or through the diaphragm into the abdominal cavity. If the hernia passes towards the surface of the body, it may be made out clinically, being indicated by a soft and compressible swelling, localised, resonant on percussion, and rendered more prominent by a cough. Pulmonary symptoms might possibly be present. It is practically impossible to detect a hernia of the lungs through the diaphragm.

FREDERICK T. ROBERTS.

LUNGS, Morbid Growths in.—The formations in the lungs which belong to the class of morbid growths may be thus enumerated, in the order of their importance: 1. *Tubercle.* 2. *Cancer.* 3. *Syphilitic gummata.* 4. *Hydatids.* 5. *Rare formations*, such as sarcoma, enchondroma, osteoid and myeloid growths, hæmatoma, lymphatic formations, actinomycosis, &c. Most of these are discussed under their appropriate headings, and it is unnecessary to allude to them any further here. Those belonging to the last group are usually rather of pathological interest than of clinical importance, with the exception of actinomycosis, as they rarely give rise to any local symptoms or physical signs during life, and are merely discovered, as a rule, at the *post-mortem* examination. It is a question how far some of these growths are to be regarded as being of a malignant nature. In some cases they are secondary to similar growths elsewhere, or the lung may be involved by extension. Lymphatic formations in the lungs are sometimes observed in cases of Hodgkin's disease.

Effects.—It will be useful to indicate the effects, if any, which morbid growths may produce in connexion with the lungs. 1. The lung-tissues may merely be more or less displaced and compressed; or, in course of time, they become absorbed or atrophied, in proportion as the growth progresses. 2. The distribution of air in the lungs may be modified by the mere presence of a growth, so that in one part it is in excess, and in another part deficient. 3. Similarly, the circulation of blood may be disturbed, leading to congestion in one part, and anæmia in another. 4. Morbid formations are very liable to cause local irritation. Hence they may induce bronchial congestion and catarrh, localised acute pneumonia and its consequences, or chronic interstitial pneumonia, which may lead to the formation of a fibrous capsule around a growth. 5. Certain formations are liable to undergo degenerative and destructive processes, which will probably involve the pulmonary tissues. In this way they originate ulcers or cavities, and may give rise to morbid products, which are not only injurious to the lungs, but also infect distant parts to which they may be conveyed. After destruction reparative processes not infrequently take place, with loss, however, of the involved portions of the lung-structures. It must be remarked here that some morbid growths seem to become infiltrated through the pulmonary tissues without destroying them; and under appropriate treatment the growth is absorbed, leaving the involved portion of the lung intact. This applies especially to some cases of syphilitic infiltration. 6. Growths in the lungs sometimes extend beyond these organs, so as to interfere with neighbouring structures, causing irritation, pressure, or destructive effects. Thus, local pleurisy, pressure on vessels or nerves, destruction of bones, and other consequences may ensue. In short, the growths become then practically intra-thoracic tumours, and produce similar effects.

Symptoms.—What has been stated as to the effects of morbid growths in the lungs will readily explain the clinical signs which they tend to originate. They may be of such little consequence that they produce no sign whatever during life, not interfering in any way with the respiratory functions, or being capable of detection by physical examination. Indeed, some formations may invade the lungs to a considerable extent so insidiously that no evident symptoms are induced. The writer has known cases in which the lungs were extensively implicated in secondary cancer without any symptoms, except some feeling of shortness of breath on exertion. Usually, however, various degrees and combinations of the ordinary pulmonary symptoms may be anticipated—namely, pain in some part of the chest, cough, expectoration, the sputum sometimes containing fragments of the growth, hæmoptysis, and disorders of breathing of various kinds. Pressure-symptoms in connexion with other structures are induced in some cases. Physical examination may detect the disease when there are no symptoms; or these may coexist with physical signs, which reveal the presence either of the morbid formation itself—such as alteration in the shape and size of the chest, deficient expansion, dulness, bronchial or other abnormal breath sounds, modified vocal fremitus and resonance; of its effects on the lungs; of the formation of cavities; or of its interference with neighbouring parts. The particulars relating to these points are discussed in other articles. Definite general symptoms are associated with many forms of morbid growth in the lungs.

Treatment.—The principles of treatment of morbid growths in the lungs are, first, to get rid of them, if possible, by medicinal means, as in the case of syphilis; secondly, to treat their effects; thirdly, to treat local symptoms which may arise; and fourthly, to treat the general symptoms.

Frederick T. Roberts.

LUNGS, Œdema of.

—Synon.: Fr. *Œdème du Poumon*; Ger. *Lungenödem.*

Definition.—Infiltration of the pulmonary tissue with serous fluid.

The serous fluid is effused from the pulmonary capillaries into the pulmonary textures, and into the alveolar and bronchial spaces.

Ætiology.—The causes of this exudation are manifold, but of two sorts:—(*a*) *Disordered circulation*: (1) active congestion, attendant upon inflammatory conditions of the lungs and bronchi; (2) passive congestion; (3) mechanical congestion—in heart-disease, emphysema, or pressure upon the pulmonary veins; (4) want of tone of vessels after inflammatory conditions, as pneumonia or bronchitis, or pressure upon the vagus nerve or pulmonary plexus; (5) afflux of blood to the lungs in croup, and during the asthmatic paroxysms determined by the ineffectual efforts at inspiration. (*b*) *Morbid conditions of the blood*: in albuminuria, and to a less degree in other diseases in which the condition of the blood is altered or impaired—for example, scurvy, purpura, anæmia, hydræmia—the lungs partaking of the general disposition to dropsy.

Anatomical Characters.—In cases of œdema pulmonum, the lungs are usually large, filling the thoracic cavity, and sometimes indented by the ribs. They are heavy; their pleural surfaces are wet; and the pleural cavities contain an excess of serum. Both lungs are as a rule affected, their lower and most dependent portions chiefly; and one lung, on the side to which the patient has last inclined, is more highly œdematous than the other. The higher the degree of œdema, the less crepitant the lung, and the more distinctly the surface pits on pressure. A portion cut from a simply œdematous lung will, however, almost always float in water; but at the base of the lung there is usually some collapse in addition to the œdema, and a portion removed therefrom sinks. On section, the lung exudes abundant thin serum, and more or less frothy fluid, with which the bronchial tubes are also occupied. On first making a section, the succulent tissue will break down easily under the finger; but, after the excess of fluid has been squeezed out, the lung feels toughened. The fluid is almost entirely confined to the alveolar spaces and parenchyma proper, as distinguished from the interlobular septa of the lung. Œdema may be found at any portion of the lung—at the apex, for instance, determined there by the inflammatory process. The transition between œdema and inflammatory consolidation is very gradual. Œdema is also very apt to pass into, or to be complicated with, a certain degree of inflammation. The degree of friability, and of compressibility, and the application of the water test, are the readiest methods of distinguishing between the two. If a portion of œdematous lung be examined under the microscope, the alveoli are found to contain more or less numerous large granular cells, but these are never so numerous as to occupy entirely the alveoli.

Symptoms.—The symptoms of œdema of the lungs are—in addition to those of the disease which has produced it—dyspnœa, which may amount to orthopnœa; troublesome 'retching' cough; and difficult, yet tolerably abundant, frothy, serous expectoration. The percussion-note is deadened at both bases, although the dulness is usually more extensive at one base than the other; the vocal fremitus is diminished; the respiratory murmur is enfeebled or lost; and a fine bubbling crepitation is heard.

Diagnosis.—The diagnosis of pulmonary œdema is not usually difficult. The absence of pleuritic pains and of fever, and the double-sidedness of the disease, together with the absence of any true bronchial breathing or ægophony, will exclude pneumonia or pleurisy. The presence of dulness will also distinguish the condition from simple capillary bronchitis, with a certain degree of which, however, it is often combined. The general condition of the patient, and the presence or absence of those diseases or circumstances which are known to produce œdema of the lungs, must be carefully taken into consideration. If, for instance, after an asthmatic paroxysm we hear some fine bubbling *râles* over the bases of the lungs, and find the patient expectorating an unusual quantity of frothy serous fluid, we may suspect pulmonary œdema rather than bronchitis.

Prognosis.—The prognosis in œdema of the lungs depends mainly upon the general or local conditions with which it is associated. It is of very grave purport in chronic Bright's disease, or in heart-disease. It is also a grave complication in chronic bronchitis, showing failure of heart-power. It is, however, often a transient and unimportant condition when it succeeds to acute chest-affections, as pneumonia or bronchitis, or to asthma. As a complication of acute chest-affections, it is rarely recognised clinically.

Treatment.—The treatment of pulmonary œdema is, in all important cases, derivative. Poultices are to be applied to the chest, with sufficient mustard to produce redness. Dry-cupping will often give great relief. Blisters should be avoided. Watery purgatives should be administered, according to the strength of the patient. Diuretics are useful in some cases, especially the vegetable diuretics, such as digitalis, juniper, and scoparium, as also spirit of nitrous ether; and the same is to be said of diaphoretics—for example, acetate of ammonium, warmth, hot-air baths. Moderate stimulation and support must be kept up. Kidney- or heart-disease, if present, will mainly determine the exact treatment. If there be failure of cardiac power, ether, ammonia, and alcoholic stimulants are required; and if the heart's action continues hurried or irregular, digitalis is especially indicated. When we suspect a loss of tone of vessels, as after bronchitis or pneumonia and in anæmic states, perchloride of iron with some mineral acid is to be recommended.

In all cases rest in bed or on a couch is necessary. R. Douglas Powell.

LUNG, Perforation of.—Synon.: The term *pneumothorax* is almost equivalent.

Definition.—The formation of an opening through the pulmonary pleura, communicating with the interior of the lung.

Ætiology.—Perforation of the lung may arise in many ways. Its causes may be classified under the four following headings:

1. *Penetrating wounds*; for example, gunshot wound, punctured wound, or laceration by a broken rib.

2. *Rupture of the lung*; as sometimes occurs during violent expiratory efforts, *e.g.* in whooping-cough, parturition, &c.

3. *Diseases affecting the pleura or neighbouring structures*; such as empyema, hepatic abscess or hydatid, or suppuration of the bronchial glands.

4. *Disease affecting the lung itself*; for instance, phthisis, emphysema, gangrene, hydatids, or cancer.

Of all the causes of perforation of the lung, phthisis is infinitely the most common. It is the rule in phthisis for pleuritic adhesions to form *pari passu* with the pulmonary lesion, and these adhesions are usually very firm and difficult to break down. In neither respect, however, does this rule always hold good. In some rare cases in the earliest stage of the disease a small tubercular nodule situated immediately under the pleura softens, and the pleura gives way. Again, at any stage of the disease an outlying tubercular mass, situated below the point to which the pleural adhesions have extended, may soften and rupture into the pleural cavity.

In the more acute pneumonic varieties of phthisis there is often a singular indisposition to the formation of pleural adhesions. The pulmonary pleura in such cases becomes covered with a thin, smooth, translucent layer of lymph, shining through which can be seen at several points opaque yellow spots. These spots are found to correspond with underlying masses of softened cheesy material, by which the pleura has been undermined and deprived of its vascular supply. Pneumothorax has its most frequent origin in rupture of the pleura at one of these yellow points.

Finally, sinuses are sometimes found leading from old cavities within the lung to the pleural surface. Occasionally these sinuses, the pleura being adherent, penetrate through the thoracic wall and point externally. In other cases, of which the writer has seen two examples, they may open into the opposite pleural cavity.

Anatomical Characters.—The affected lung is in all cases collapsed, and in cases of old standing may be so completely so, and covered by such thick layers of lymph, as to be found only with difficulty. The opening may have closed. It is sometimes difficult to discern. It may consist of a small slit, communicating with a cavity by a slanting sinus, so as to form a complete valve; or it may be of considerable size, and communicate widely with a cavity or bronchus. All degrees of patency between these two extremes occur. The position of the opening is very variable; it is most commonly situated somewhere on the lateral or convex side of the lung. The rupture is almost always into the pleural cavity on the same side. It may, however, take place into the opposite pleural cavity, through the mediastinal fold of pleura. The pleura is inflamed, and covered with lymph; and its cavity contains air and a greater or less quantity of purulent fluid. The heart is displaced, unless in some rare case it be held by a strong adhesion. Some years ago the writer tested the degree of air-pressure present in ten cases of pneumothorax by means of a water-pressure gauge. In two cases it was *nil*; in one case it was equal to 1·25 inch; in two cases 2 inches; in one case 3·75 inches; in two cases 4 inches; in one case 5·3 inches; and in a double case it equalled 3·5 inches in one pleura, and 2·7 in the other. The gas effused approximates in composition to that of expired air, containing from 8 to 16 per cent. of carbonic acid. Sometimes sulphuretted hydrogen also is found in fœtid cases.

Symptoms and Signs.—The symptoms and signs of perforation of the pleura are those of pneumothorax, followed by hydro- or pyopneumothorax. At the moment of attack sudden acute pain is felt in the chest, at the seat of rupture, and is immediately followed by great dyspnœa and shock. In a well-marked case the expression of face is peculiarly agonised and terror-stricken; the extremities are cold; damp sweats break out; the pulse is quick and small; and the respirations are exceedingly rapid. The position of the patient is that of orthopnœa, with an inclination forwards, and to the sound side; it is, however, frequently changed in the endeavour to gain breath. The voice is feeble and whispering. The urgency of the shock and dyspnœa depends upon the amount of useful lung suddenly disabled. If the patient survive the attack, after two or three days fever of a hectic character, with sweats, supervenes. In some cases, however, the symptoms of pneumothorax come on very insidiously.

Physical signs.—The physical signs are very characteristic. There is enlargement of the side affected, and effacement or bulging of the intercostal spaces. The heart is displaced towards the sound side. The percussion-note is hyper-resonant or tympanitic over the side affected, except where (at the apex) the lung may perhaps be still adherent; and on auscultation either no respiration at all is audible, or amphoric breathing of a peculiar character may be heard at one or more points, sometimes accompanied with the characteristic metallic tinkle. A peculiar metallic echo is heard if the patient coughs. If, whilst the ear is applied, a coin placed on the diseased side is struck with another coin, a characteristic bell-note is heard. The vocal fremitus is diminished or lost. At a later stage, when more or less effusion has taken place, the signs of air and fluid in the pleural cavity present themselves, namely, dulness below and hyper-resonance above—in varying proportions, and shifting in relative position with the posture of the patient. If the amount of fluid be moderate, a splash or succussion sound may be elicited. This sound may be audible to the ear applied to the chest, or to bystanders. If the fluid effusion be considerable, intercostal fluctuation may be felt; and this fluctuation gives to the finger, on percussion at the level of junction of air and fluid, a peculiar sensation of thrill. The position usually assumed by the patient now is with the head raised, and leaning towards the diseased side.

Diagnosis.—The diagnosis of perforation of the lung is to be made from other diseases; and also with respect to the probable nature of the opening, and the degree of pressure present. If the three essential signs of pneumothorax be remembered, namely, displacement of heart, tympanitic percussion-note, and either absence of respiration or amphoric breathing, there can scarcely be any difficulty in making the diagnosis. It cannot be confounded with a bilateral disease like emphysema. The shifting resonance and dulness, the succussion-splash, with perhaps metallic tinkle and amphoric breath-sound, are signs abundantly sufficient to distinguish hydro-pneumothorax from ordinary empyema. It is sometimes very difficult to distinguish between a *localised* pneumothorax and a large thin-walled cavity in the lung, the signs being almost identical. Respecting the nature of the opening, whether valvular or free, careful auscultation will usually gain the desired information. If amphoric breathing be well-marked, it may be assumed that the opening is a free and tolerably direct one; if, on the other hand, no respiratory sound be audible, the communication with the pleura is indirect and more or less completely valvular. In the latter case the pressure-symptoms become more urgent.

Prognosis.—Of course the prognosis in every case of tubercular pneumothorax is necessarily very grave, but by no means equally grave in all cases. The following considerations will guide to a correct prognosis: (*a*) *Nature of opening.* If the communication with the pleura be valvular, signified by the entire absence of breath-sound, and the increasing urgency of dyspnœa, the patient will die in a few hours unless relieved by paracentesis. (*b*) *State of the opposite lung.* If the effusion of air have occurred on the side least affected by previous disease, the case is correspondingly hopeless. If, on the other hand, we know that the lung now collapsed was previously much diseased, and if the other lung be but little affected, the duration of life may not be greatly shortened by the accident. Life is then gradually extinguished by hectic fever, and progressive disease in the opposite lung. It is by no means impossible, and probably happens more frequently than is supposed, that the opening in the pleura may close, the air become absorbed, and the case converted into one of simple empyema. In pneumothorax arising from accidental wound or injury to the lung, the prognosis depends upon the visceral injury. The air in the pleura is absorbed with considerable readiness.

Treatment.—In all cases in which death is threatened by asphyxia, in consequence of air accumulating in the pleura, paracentesis with a fine trocar must be performed. This will in such cases give great relief, and may be repeated if necessary. There is a tendency for an opening, at first completely valvular, to become at a later period more patent, or possibly to close, so that it is better to operate when necessary with a fine trocar than to make a permanent opening. Rest to the affected side should be secured, as far as possible, by the application of a broad piece of strapping extending round the side to beyond the middle line in front and behind. The shock and dyspnœa are best treated by opium in repeated small doses. Stimulants may also be necessary, but opium is far more useful.

R. Douglas Powell.

LUNG, Rupture of.—Rupture of the lung is an extremely rare occurrence. Cases of so-called rupture of the lung from external violence are, for the most part, really produced by perforation or laceration of the pleura by a fractured rib. It is said that rupture of the lung may occur in whooping-cough. *See* Lung, Perforation of.

LUNGS, Syphilitic Disease of.—There can be no doubt that syphilis does sometimes originate specific lesions in the lungs, though much less frequently than in most of the other viscera. They are generally only met with in advanced cases of acquired syphilis, when the signs of the disease are markedly developed in other parts. Occasionally the lungs are involved in congenital syphilis. The presence of a tubercular or scrofulous diathesis has been supposed to predispose to the implication of the lungs in syphilitic disease.

Anatomical Characters.—*Gummata* constitute the most certain and unquestionable lesions of a syphilitic nature in the lungs, but they are rare. When present, they vary in number from one to many. In the latter case they are disseminated, but are stated to have a predilection for the deeper parts of the organs. In size these growths usually vary from that of a pea to a walnut, but may reach the dimensions of a large egg. They are generally well-defined, rounded in shape, and often surrounded with a fibrous capsule. In their early condition gummata in the lungs appear on section greyish or brownish-red, homogeneous, firm, and dryish in consistence. Subsequently they tend to degenerate, becoming more or less caseous, yellow, and less consistent; and they may even break down in the centre, so as to form cavities. The structure of these gummata is found on microscopical examination to be made up of imperfect fibres, abortive nuclei, and a few fibre-cells, infiltrating the pulmonary tissues, and thickening the alveoli. Afterwards these are mixed with granular matter and other products of degeneration and disintegration.

There seems every reason to believe that a variety of *chronic interstitial pneumonia* is in exceptional instances due to syphilis. The result is a fibroid infiltration of the pulmonary tissue, which in its general and microscopic characters cannot be distinguished from a similar condition due to interstitial pneumonia from other causes, but the new tissue is said to be more vascular in its early stages. The affected parts are much indurated; and any bronchi which are implicated tend to become more or less dilated. The morbid condition may be distributed in various parts of the lungs, but appears to have a preference for their bases and the vicinity of their roots. It frequently originates at the surface, and penetrates thence into the interior of the lungs in the form of fibrous bands, the pleura being generally thickened and adherent, and superficial puckerings and depressions being visible. In other instances the new-growth commences around gummata; or from a chronic contracting peri-bronchitis, associated with ulcerative inflammation (Pye-Smith). Dr. Green states that it originates mainly around the small interlobular blood-vessels. Syphilitic fibroid infiltration has no tendency to caseation; but it may become the seat of ulceration or gangrene.

In connexion with congenital syphilis, a peculiar condition has been described as affecting the lungs in new-born or very young infants, under various names, such as *syphilitic pneumonia*, *white hepatisation*, and *epithelioma of the lungs*. It assumes a more or less diffuse or infiltrated arrangement, but is of variable extent, and may involve one or both organs. One lung may be affected throughout, while the other is quite free from disease. The more obvious characters are as follows: The pleura is usually unaffected. The lung is enlarged, and may be in a state of full expansion, so that its surface is marked by the ribs; it feels remarkably heavy; and at the seat of the disease is dense, firm, hard, and usually resistant, not breaking down under pressure. On section it presents a white or yellowish-white colour, being more or less bloodless; is uniform and smooth; and little or no fluid can be expressed or scraped from the cut surface. Careful examination reveals minute bands of fibrous tissue running in all directions. Microscopically the change seems to consist mainly in thickening of the alveolar walls and minute bronchi, due to an imperfectly fibrillated and nucleated tissue, which undergoes degenerative changes. Most observers further describe an increase in the epithelial cells, which fill the air-vesicles and minute air-tubes; but Wagner denies this. The vessels also become thickened and ultimately obliterated.

It may be remarked that the bronchial tubes or their divisions may be affected with syphilitic disease; their submucous tissue, or occasionally their deeper structures, becoming infiltrated with a fibro-nuclear growth. Ulceration is likely to take place, followed by cicatrisation, leading to thickening of their walls, with narrowing or even complete closure of their channel.

Symptoms.—In the majority of cases syphilitic lesions in the lungs have only been discovered after death, no symptoms having occurred during life pointing to these organs; or they having been obscured by symptoms affecting other parts. In a case of recognised constitutional syphilis, attention should be paid to the lungs as well as to other organs, and it would be advisable to examine them from time to time, as physical signs might occur without any obvious symptoms to attract the patient's attention. If pulmonary symptoms, such as local pain, shortness of breath, cough, expectoration, or hæmoptysis, should arise in a person undoubtedly syphilitic, or who had had syphilis, the possibility of the lungs being affected should specially be borne in mind. Hæmoptysis at an early period is said to be of diagnostic importance. Physical examination might possibly reveal the presence of gummata, as evidenced by localised dulness, bronchial breathing, increased vocal fremitus and resonance, and other signs of consolidation. The most significant signs, however, are those indicating marked induration of the lung from fibroid infiltration, especially if unilateral, and confined to the base or middle portion of the organ. In course of time signs of cavities might become evident, due to breaking-down of gummata, or to dilated bronchi. The general symptoms are those of constitutional syphilis, combined with those of phthisis. There is but little or no pyrexia accompanying the pulmonary lesions; and the progress of the case is essentially chronic. The effects of treatment may be of peculiar significance in the diagnosis of syphilitic disease of the lungs. If such symptoms and physical signs connected with these organs as have been indicated above should disappear under the use of anti-syphilitic remedies, a diagnosis of this disease might fairly be made. The absence of tubercle bacilli is considered an important element in distinguishing syphilitic disease from tubercular phthisis.

Treatment.—If syphilitic disease of the lungs be recognised or suspected, the appropriate treatment in most cases is to administer iodide of potassium freely and continuously. In some cases a mercurial course of treatment answers best; or perchloride of mercury might be combined with the iodide. It may be necessary to employ internal remedies or local applications for the relief of pulmonary symptoms. Cod-liver oil and tonics may be given with advantage for the amelioration of the general condition, in cases where such medicines are needed. The usual measures for the treatment of phthisical cases, as regards diet, hygiene, climate, &c., must of course be duly recognised, and adopted in suitable cases.

Frederick T. Roberts.

LUNGS, Tuberculosis of.—Tubercle is the most important morbid growth affecting the lung, but it is by no means a settled point what should be included under this term. Many pathologists only recognise as tubercle the so-called grey granulations; others regard the various masses and infiltrations noticed in cases of phthisis as of this nature, and they look upon tubercle in these organs as divisible into grey and yellow varieties, and arranged either in the form of granulations or as an infiltration. It is unnecessary in this place to discuss this subject further, as it is considered fully in other appropriate articles. *See* PHTHISIS; and TUBERCULOSIS.

FREDERICK T. ROBERTS.

LUPUS ERYTHEMATOSUS (*lupus*, a wolf, or a rodent disease; and *erythematosus*, related to erythema).—SYNON.: *Seborrhœa Congestiva*.

DEFINITION.—A chronic hyperæmia of the skin, attended by a new-cell-growth, followed by interstitial absorption, and ending in scar.

ÆTIOLOGY.—Women are more liable to lupus erythematosus than men. It is rare before puberty, and most often begins between the ages of 20 and 45 years; but no age of adult life up to 60 or 70 is exempt. Weakly persons are thought by some to be most liable, but the complaint may attack perfectly healthy people—at any rate there is no intimate connexion with any other special disease. An imperfect circulation, such as evidences itself by congestion of parts which are at a disadvantage, *e.g.* the nose or ears, is probably a causal factor; any cause which leads to temporary congestion, such as exposure to heat or cold, may act as a determinant. Lupus erythematosus is not hereditary. It attacks all classes of society.

ANATOMICAL CHARACTERS.—The capillaries of the cutis are dilated, and a small-celled new-growth develops in it, close under the epidermis, around the orifices of the sebaceous and hair follicles and the sweat-ducts. The cell-growth has lately been said to commence deeper down in the substance of the skin. There is an increased secretion of sebum; and crusts of epidermis and fatty matter form. The terminal scar is due to destruction of normal tissue by the new-growth; partial fatty degeneration and absorption of the latter; and conversion of the remainder into permanent connective tissue.

SYMPTOMS.—Lupus erythematosus most often attacks the face. Small patches of well-defined crimson or purplish redness form on the skin of the cheeks or nose, and remain for a long period unaltered; they then become covered in parts with thin, firmly adherent, dirty-looking crusts, which if removed are found to send processes into the dilated mouths of the sebaceous glands. In the final stage, the redness gives place to a very superficial whitish scar. Confluence of several small patches gives rise to irregular patterns. In some cases it is impossible to recognise anything more than persistent redness due to dilated capillaries, and very superficial scarring where the disease is undergoing involution. When both cheeks are attacked at once, the patches tend to unite across the nose in the shape of a bat's wing or of a butterfly. The scalp often suffers, and there is permanent loss of hair. Other seats of lupus erythematosus are the ears, eyelids, lips, and backs of the hands; where it may closely simulate chilblains at first. No part of the body is exempt. There is no pain, or ulceration, but sometimes slight itching. Exposure to cold winds or to great heat aggravates the disease. In Germany an acute form has been observed, in which the eruption quickly covers a large part of the body; is attended with fever and prostration; and may end in death. The writer has seen such a case.

COMPLICATIONS.—Recurrent erysipelas has been noticed more often in lupus erythematosus than in lupus vulgaris.

DIAGNOSIS.—This disease is to be diagnosed from lupus vulgaris, by its commencement after puberty; by its very superficial character; and by the sebaceous crusts. From eczema, which it sometimes resembles at first sight, lupus erythematosus may be distinguished by the history, chronicity, trifling itching, and the presence of scars.

PROGNOSIS.—Lupus erythematosus is very chronic, and may last for years. Permanent cure is very doubtful, on account of the tendency to relapse. Except in the acute form, which is rare, there is no danger to life.

TREATMENT.—In the treatment of lupus erythematosus the first indication is to rectify any derangement of the general health. There is no specific internal remedy. Milk and cod-liver oil improve the nutrition. Externally, mild caustics suit some cases best. Mercury plaster should always be tried, spread thickly on linen, with enough oil of turpentine to make it soft, and applied every night for a long period. The liniment or tincture of iodine can be painted on until slight inflammation is set up, and repeated after an interval; or spirit of soap (℞ Saponis mollis ℥j, spiritûs rectificati ℥ss–℥j) may be rubbed on with a piece of lint; after the serous crusts resulting from this separate, the same process should be repeated. Pyrogallic acid ointment (10 per cent.) has been recommended. It is applied for three or four days until a brown eschar forms; this is covered with iodoform bandage until the slough separates; the wound is then dressed with iodoform. Painting with a 3 per cent. solution of resorcin, and covering with an india-rubber mask, have been effectual. One of the best methods of local treatment is that by linear scarification (*see* LUPUS VULGARIS). Some cases, especially those where there is much active inflammation, do best with soothing remedies—such as zinc ointment, or a lead lotion (℞ Liquoris plumbi subacetatis ℥j, glycerini ℥ij), applied warm after the crusts are removed; and such applications are always of service in the intervals between the caustics.

Edward I. Sparks. Alfred Sangster.

LUPUS VULGARIS (*lupus*, a wolf, or a rodent disease; and *vulgaris*, common). Synon.: *Lupus Exedens*; Fr. *Scrofulide Maligne*; *Dartre Rongeante*; Ger. *Lupus*; *Fressende Flechte.*

Definition.—A very chronic non-contagious disease of the skin and mucous membranes; chiefly due to an infiltration of small round cells into their substance; attended either with epidermic exfoliation, interstitial absorption, or destructive ulceration.

Ætiology.—The ætiology of lupus vulgaris is unknown. Some cases occur in scrofulous persons with enlarged or suppurating lymphatic glands, and diseases of the bones and joints, or in the children of consumptive parents. An association between lupus and struma is generally admitted in this country, although it is not traceable in every case. Most cases begin very early in life, from the second or third year up to puberty. The ulcerative form—*lupus exedens*—may begin still later, but it is very rare for it to do so after the thirtieth year. Women are more liable to lupus than men, and country people than townspeople. It is in no way due to syphilis, either hereditary or acquired. Local injury may determine the disease. Lupus is probably a local tuberculosis.

Anatomical Characters.—The cutis in lupus is infiltrated with vast numbers of small round cells of about 0·004 mm. in diameter, which encroach on and gradually destroy its proper tissues. The new-growth has a certain resemblance to granulation-tissue (Virchow). It is highly vascular, and contains new-formed capillary vessels. Nodules have been described, disseminated through the cutis, each consisting of one or more central multinuclear giant-cells, surrounded by bands of smaller cells which shade off into the granulation-tissue. These nodules exactly resemble grey tubercle (Friedländer). Some authorities regard these giant-cells as retrograde products, due to central fusion of the endothelial cells of sweat-ducts, blood-vessels, and lymphatics, with persistence of their nuclei (Lang). The epidermis covering the lupus-tissue is thickened; the lower cells of the rete mucosum are fattily degenerated, and contain reddish pigment. Lupus-tissue is very persistent. It may either undergo fatty degeneration and subsequent absorption, without lesion of the epidermis; or else the latter breaks down too, and ulceration is the result. A certain amount of organisation of the new-growth into connective-tissue takes place. Koch has demonstrated the existence of bacilli in lupus-tissue indistinguishable from the tubercle bacillus; other observers have had difficulty in finding bacilli. The structure of lupus and miliary tubercle are very closely alike.

Symptoms.—Lupus usually begins as one or more small, smooth, reddish-brown or reddish-yellow blotches, from the size of a pin's head to a split pea, which may be level with the skin, or else raised in the form of small tubercles. Several of these may become aggregated into a patch, and a number of them may coalesce, so as to cover extensive surfaces of skin; but this is the exception rather than the rule. Any change that occurs is always slow, and a patch the size of a shilling or a florin may take years to form. In the non-ulcerative variety, thin epidermic scales are continually thrown off from the surface of the tubercles—*lupus exfoliativus.* After a while, interstitial absorption of the lupus-cells begins in the older tubercles, and a bluish-white papery scar is left. In other cases the tubercles soften, ulcerate, and become covered with greenish-yellow adherent scabs, beneath which the ulcer extends. The surrounding parts are swollen, and the edge of the ulcer is pinkish. Removal of the scab exposes an ulcerating surface bathed in pus; sooner or later granulations appear, and are liable to be exuberant. The ulceration may attack structures deeper than the skin, and destroy cartilage, fibrous tissues, and muscle. The mucous membranes are not often primarily affected by lupus, though it often extends to them from the skin. The gums, buccal membrane, pharynx, larynx, and epiglottis may be invaded, or the conjunctiva or vagina.

Lupus may occur on any part of the body or limbs, but it has a special preference for the skin of the face; afterwards, in order of frequency, the limbs, buttocks, trunk. The ulcerative form—*lupus exedens*—begins almost exclusively on the nose, attacking chiefly its anterior portion, either the tip or the edges of the alæ. Sometimes it begins within the nostril. Unless proper treatment is adopted the nose may be entirely destroyed, and severe inroads made into the tissues of the cheeks, lips, and other neighbouring parts. The varied aspects that may be assumed by lupus have suggested the terms *L. disseminatus*, *L. hypertrophicus*, where there is much infiltration; *L. serpiginosus* and *L. verrucosus* or *papillomatosus*, in cases where the disease assumes a papillary type.

Complications and Sequelæ.—Lupus may co-exist with enlarged and suppurating glands in the neck and elsewhere; with various scrofulous affections; with phthisis; and with chronic Bright's disease. Great deformity may result from the contraction of the scars which it leaves—for example, ectropion, stricture of the nares, and distortion of the mouth. About a dozen cases have been recorded in which epithelioma developed on a patch of lupus of many years' standing, or on a lupus scar. We may regard such cases as arising from the stimulus of the proliferative processes in the cutis on the neighbouring epithelium.

Diagnosis.—The duration and position of lupus vulgaris, and the absence of thick scaliness and itching, will generally render it easy to distinguish this disease from circumscribed forms of psoriasis and eczema; from epithelioma there may be difficulty in middle-aged and old people. The age at which the disease commenced, pain, induration, position, and secondary involvement of glands, help the diagnosis in cases of epithelioma. It is with syphilis that lupus is most apt to be confounded; and the diagnosis between lupus exedens on the nose, and an ulcerating syphilide, is sometimes extremely difficult, or at first sight impossible. In these cases, after carefully considering the history, we must examine other parts of the body for traces of syphilis, and an inspection of the mouth and pharynx will often materially assist us; and lastly, the greater chronicity and slower extension of lupus, as well as its resistance to specific treatment, will generally lead to a correct opinion. Indolence is a character of special value in deciding between lupus and syphilis, particularly as affecting the mucous membranes. Syphilis has also more tendency to suppuration than lupus; and is liable to attack bone. Lupus has to be distinguished from scrofuloderma, which generally commences in softened gland-tissue, and has a tendency to attack the subcutaneous tissue primarily—hence pocketing and forming sinuses.

Prognosis.—Lupus is never fatal *per se*, but it can never be looked on in a favourable light, owing to its tendency to relapse under treatment, and its invariable termination in a contracting cicatrix.

Treatment. — *Internal.* — Internal treatment is only of use in lupus vulgaris where the patient's general health is bad, or where well-marked symptoms of scrofula are present. In these cases great benefit may be derived from tonics, especially the iodide of iron, and from cod-liver oil in as large doses as can be tolerated. Nutritious food should be freely given; and the patient should take plenty of outdoor exercise, but be protected from damp, cold, and sudden changes of climate.

External.—The real cure for all forms of lupus must always consist in the destruction of the new tissue forming it, by caustic agents of various strengths. A number of such remedies have been proposed, but the successful application of each seems often to depend more on individual experience of its use, than on the superiority of any one caustic over the rest. A few of those more generally used may be mentioned. Arsenical paste (Arsenious acid gr. 10; artificial cinnabar, ʒss.; rose ointment, ℥ss. (Hebra)), to be spread on linen applied evenly, and bound on the affected part for twenty-four hours; one or two applications may be necessary. The diseased tissue is selected and destroyed by the paste, but the pain is severe. Only limited areas are to be treated. Chloride of zinc paste applied for twenty-four hours is well spoken of. Equal parts of caustic potash and distilled water may be applied with a tiny piece of sponge, so as to limit the action as much as possible. The pain which follows is not of long duration—a point of much importance where a caustic must be repeatedly used. Solid nitrate of silver may be bored freely into all ulcerated parts or soft tubercles. The lupus-tissue offers but slight resistance to it, whereas it will not penetrate or injure healthy parts. This is a safe and harmless method. Acid nitrate of mercury may be painted on with a glass brush. The crusts which form fall off in ten days or a fortnight, and it is not advisable to repeat the application at shorter intervals. As a rule, no dressing except zinc ointment is required. Some authorities prefer the actual or else the galvanic cautery, but both these measures have the disadvantage of disfiguring the parts, so that it is difficult to determine when healthy tissues are reached. In the treatment of the superficial patches of lupus non-exedens, the repeated application of mercurial plaster during several months has sometimes been followed by absorption of the growth. Pyrogallic acid ointment (1 to 10) has been used by Hebra and others with much success. Salicylic acid, enough to make a paste with glycerine, applied to affected parts, destroys the ulceration, and answers well. Where no ulceration exists, demanding active interference, milder remedies deserve a trial, such as lead or calamine lotions. It is often surprising how much improvement may be got by such measures, combined with suitable hygiene.

The local treatment of lupus which now finds most favour is that invented by Volckmann, known as scraping and multiple punctiform scarification.

1. *Scraping* has for its object, first, the removal of products of secretion, scabs and crusts; and, secondly, the removal of neoplasms formed in or on the skin. For this purpose 'spoons' or 'scrapers' of various sizes are made by the instrument-makers. It is difficult to make any impression on the sound skin with such blunt instruments, and on this fact the simplicity and safety of scraping mainly depend. It is almost impossible to do harm, for all that can be made to break down (using moderate force), under the scraper or spoon, is best removed.

2. *Multiple punctiform scarification* is the second mechanical method employed by Volckmann. By this the operator seeks, first, to destroy newly formed vessels; and, secondly, to favour absorption of the neoplasm, by traumatic irritation of the part. It is practised by making hundreds of punctures close together, about two lines in depth. For this purpose a narrow-bladed bistoury may be used; or the same end is gained in less time by employing one of the various instruments made for the purpose, composed of two or more knives set close together. This method of treatment is more applicable to non-ulcerated parts, where the cell-infiltration is diffuse. Such tissue might in some cases be made to break down under the spoon, but less scarring or deformity results if the neoplasm can be made to disappear by the method of puncture.

There is considerable bleeding at first, after either scraping or puncture. This, however, is soon controlled by the application of sponges squeezed out of iced water. The part may be dressed after operation with some simple antiseptic dressing.

Another method is that by linear scarification. This is more suitable to extremely superficial varieties, and especially to lupus erythematosus. It is practised by making in the part numerous parallel incisions about $\frac{1}{8}$ of an inch apart. Different instruments have been invented for the purpose. After a number of parallel incisions are made in one direction, others are made crossing these, so as to mince up the skin, so to speak, and by this means destroy the new-growth and occlude the vessels.

The treatment of lupus by Koch's tuberculin.—This depends on the subcutaneous injection of a toxine derived from a bacillary extract, giving rise to general and local phenomena: the former as constitutional disturbance, fever, congestion of viscera, &c., the latter as inflammatory and absorbent effects at the seat of lesion. The treatment was carried out systematically at the St. Louis Hospital, Paris, soon after its introduction. An analysis of the thirty-eight cases treated will be found in the *British Journal of Dermatology* for March 1891. It was observed that the reaction varied in individuals, as to intensity and duration, even when the dose was very small: as complications were noted—congestion of the lungs, endocarditis, hæmaturia, albuminuria, scarlatiniform eruptions, and erysipelatous inflammation of the face and scalp. As to local effects, not one case was reported cured, in twelve cases the results were *nil*, in eighteen there was 'very slight improvement.' The treatment has been generally abandoned on account of its danger to life and its doubtful efficacy. It is still believed in by some dermatologists, as of use in supplementing operation: it helps to get rid of deep-seated lupus tissue, out of reach of the curette or antiseptics (Crocker). There seems some reason for believing that the long-continued systematic employment of minute doses of tuberculin (1 mg.) may cause absorption of lupus or of scar-tissue, without producing local inflammation or general disturbance (Pringle).

EDWARD I. SPARKS. ALFRED SANGSTER.

LYMPH (*νύμφη*, a nymph, water).—Physiologically, lymph signifies the fluid which circulates in the lymphatic system. Pathologically, the term is applied to the coagulable exudation which escapes from the vessels in inflammation. The name 'vaccine lymph,' or 'lymph,' is also given to the fluid contained in the vaccine-vesicle. *See* INFLAMMATION; and VACCINIA.

LYMPHADENITIS (*lympha*, lymph; and *adenitis*, inflammation of a gland).—Inflammation of lymphatic glands. *See* LYMPHATIC SYSTEM, Diseases of.

LYMPHADENOMA.—SYNON.: Hodgkin's Disease; *Anæmia Lymphatica* (Wilks); Fr. *Adénie* (Trousseau); *Lymphadénie* (Ranvier); Ger. *Pseudoleukämie* (Wunderlich).

DEFINITION.—A disease characterised by more or less widely spread enlargement of the lymphatic glands, accompanied frequently by enlargement of the spleen, and by progressive anæmia.

HISTORY.—Cases of coincident enlargement of the lymphatic glands and spleen were noted by Malpighi (1669) and Morgagni (1752). The nature of the glandular change was first carefully described by Craigie (1828); and the general clinical history of the affection was pointed out by Hodgkin (1832), and by Wilks (1856). The most important subsequent observations are those of Virchow (1864), Wilks (1865), Trousseau (1865), Wunderlich (1858 and 1866), Murchison (1870), and Meisner (1884).

NATURE.—The enlargement of the lymphatic glands, which consists at first of mere hyperplasia, and subsequently of fibroid induration, varies much in its extent. A few glands only may suffer, or every gland in the body may be enlarged. The former cases have the characters of a local growth; the latter is distinctly a general disease, for which the term *lymphadenosis* seems the most exact. The glands vary in consistence: when soft there may be a considerable excess of leucocytes in the blood; when hard there may be simple anæmia. This difference does not afford sufficient ground for separation. The enlargement of the spleen is usually due to disseminated growths, arising in the Malpighian bodies; sometimes there is also hyperplasia of the splenic pulp, as in splenic leucocythæmia.

ÆTIOLOGY.—In two-thirds of the cases of lymphadenoma, no cause can be traced, and the ascertainable antecedents of the disease, in most of the remaining cases, evidently constitute only a small part of the influences to which it is due. Hereditary transmission has not been distinctly proved. The disease is three times as frequent in males as in females. It is met with at all ages, but is most frequent in early and late adult life. It occurs, but is not specially frequent, in children under ten years; and, having regard to the numbers living, it is least frequent between the ages of forty and fifty years. Intemperance, mental depression, insufficient food, and over-exertion have been noted, in rare cases, as antecedents. Exposure to cold, in several instances, has appeared to be the exciting cause of the affection. It is doubtful whether the disease has any relation to constitutional syphilis. In several cases the symptoms have first appeared after childbirth. Various febrile affections have, in a few instances, preceded the affection. The exciting cause which has been noted most frequently is some local irritation, as of a decayed tooth, discharge from the ear, sore-throat, inflammation of the lacrymal sac, or eczema. In these cases the glands nearest the source of irritation first enlarged, and then more distant ones became affected.

Anatomical Characters.—The several groups of glands are affected in the following order of frequency, beginning with those most commonly diseased: cervical, axillary, inguinal, retro-peritoneal, bronchial, mediastinal, mesenteric. Subsidiary adjacent glands are often enlarged together with the chief groups; and nodular growths, similar to enlarged glands, arise in the course of the lymphatics in places in which the existence of glands is not usually recognised, so that continuous chains of nodules connect the various groups. The size attained by the glands in lymphadenoma varies from that of a bean to that of a hen's egg. At first the individual glands are separate and movable one on another. Ultimately they often unite to form a conglomerate mass, in consequence, in most cases, of the perforation of the capsules of the glands by growth, which may also invade adjacent parts. The cervical glands are usually enlarged in both the anterior and posterior triangle; and the sub-maxillary glands may encircle the neck beneath the lower jaw. They may press on the trachea or larynx, displace the latter, compress the internal jugular vein, and cause paralysis of the recurrent laryngeal nerve. The occipital glands are usually also enlarged. The axillary glands often form a mass of very large size, and prolongations may extend beneath the pectoral muscle. The glands in the anterior mediastinum frequently suffer, and the growth may extend to adjacent structures, such as the pericardium, which may be perforated. The thymus may be involved, secondarily or primarily, or may escape. The bronchial glands are diseased more frequently than the cardiac glands, and the trachea and bronchi may be pressed upon, or the lung invaded. The retro-peritoneal glands often form a mass of large size, which may surround and compress the solar plexus, causing symptoms similar to those of Addison's disease. Enlargement of the mesenteric glands is neither common nor considerable. The inguinal group is frequently diseased, and the femoral vessels and crural nerves may be thereby compressed.

The consistence of the enlarged glands may be either soft or very hard. Usually the longer the enlargement has existed, the firmer are the glands. Their section is more uniform than in health. The colour is yellowish or whitish-grey. In the firmer glands dense tracts of fibrous tissue are seen to pass in different directions. Rarely the follicles have a different appearance, being opaque and yellowish from fatty degeneration, whilst the septa are white and conspicuous, from fibroid thickening. Caseation is, however, rare, and when it occurs is commonly confined to one or two glands. The softer glands yield a juice on scraping; the firmer glands yield no juice. In the former, the only histological change is an enormous increase in the cellular elements—the lymph-corpuscles of the reticulum; but the relations of the septa and follicles often remain normal. Sometimes the cell-growth invades the septa, which become split up and disappear; and it may even, in a similar manner, perforate the capsule. The firmer glands present much fibrous tissue, which may be confined to the septa, or invade also the delicate network in the substance of the gland; and then the cells gradually disappear, and the whole substance of the gland may be transformed into a fibrous mass. The tracts of fibrous tissue may have under the microscope a peculiar vitreous aspect, especially around the arteries.

The spleen is diseased in at least four-fifths of the cases, usually in consequence of disseminated growths, often irregular in shape, arising from the Malpighian corpuscles, yellowish or greyish-white, rarely caseating, and usually corresponding in consistence with the glands in the same case and resembling them in structure. The splenic pulp may be normal in quantity, or may be compressed and atrophied. In some cases it is also increased in quantity, and this increase may even be the sole change. In such cases the morbid changes of lymphadenoma and splenic leucocythæmia coexist, and there is often a much greater increase in the white corpuscles of the blood than when the spleen is the seat of simple growths. The size attained, in the cases of nodular growths, is not great, the weight being from ten to thirty ounces. When the splenic pulp is increased, the size attained is rather greater. In the latter case the enlargement is uniform, while it may be irregular when there are growths. The medulla of bones has been found, in rare cases, to present a change similar to that met with in splenic leucocythæmia and pernicious anæmia. Collections of adenoid tissue elsewhere often undergo changes similar to that of the lymphatic glands. The tonsils, the mucous membrane of the pharynx, the œsophagus, the stomach, and the large and small intestines, may all be the seat of growths, originating in the follicular glands, and sometimes ulcerating. The liver is often the seat of scattered lymphoid growths, usually minute, varying in size from a pin's head to a small pea. They occupy the interlobular spaces. Rarely larger nodular growths are found. In other cases the liver is simply congested. Similar minute growths are often found in the kidneys, chiefly in the cortex; and these organs may also be the seat of parenchymatous degeneration. The peritoneum may be inflamed over enlarged glands, or may be the seat of growths. Growths have also been found in the testicles; and frequently in the lungs, where they may break down and form cavities.

SYMPTOMS.—The most important symptoms of lymphadenoma are due to the altered blood-state, and to the enlarged glands. The latter cause the earliest symptoms, and the cervical glands are commonly the first to enlarge. When the internal glands are primarily affected, pain and pressure-signs may precede other symptoms. Occasionally the signs of anæmia precede those of the local change; and, in rare instances, irregular febrile disturbance may occur before the glandular enlargement. The affected glands are smooth, and present, at first, a peculiar mobility, which may disappear when they become adherent, and constitute an irregular lobular tumour of some size. They are usually painless, except during periods of rapid growth. A diminution in size has been observed before death. The enlargement of the cervical glands may cause the neck to equal, or even exceed, the head in circumference. The pressure on the veins may cause symptoms of passive cerebral congestion. The larynx may be displaced; and the movements of the lower jaw may be interfered with. Pressure on the trachea, by the glands in the neck and in the posterior mediastinum, may cause dyspnœa and even death by suffocation. That on the pharynx and œsophagus may obstruct deglutition, and cause death by starvation. The enlargement of the axillary and inguinal glands may interfere with the movement of the limbs, and impede the circulation. Various and serious pressure-effects result from the enlargement of the thoracic and abdominal glands, obstruction in veins, pressure on nerves, &c. The enlargement of the spleen can usually readily be felt, but does not commonly give rise to symptoms. Anæmia is one of the conspicuous symptoms, and may precede, or succeed, obtrusive affection of the glands. The red corpuscles may be reduced to fifty, thirty, and even twenty-five per cent. of the normal. In most cases there is no marked excess of white corpuscles, but occasionally they are much more numerous than normal. In almost all cases in which their excess is comparable to that met with in splenic leucocythæmia, the splenic pulp is increased in quantity, and the lesions of splenic leucocythæmia and of lymphadenoma are conjoined. The liver may be enlarged from the disseminated growths, and from congestion. Jaundice only occurs from the pressure of enlarged portal glands upon the bile-ducts. Ascites may be due to similar pressure, or to the blood-state, being then part of general dropsy. The function of the kidneys is rarely affected. Stomatitis, sometimes ulcerating, results from the lymphoid growth in the mucous membrane; and a similar change in the stomach causes interference with digestion and vomiting—symptoms which are increased by the anæmia. Slight dyspnœa results from the blood-state, while intense difficulty of breathing, and even actual suffocation, may occur from the pressure of enlarged glands on the trachea or bronchi. The functions of the nervous system are variously deranged by the ill-nourished blood. Towards the end there may be convulsions, delirium, and coma. Pyrexia is a frequent, but not invariable, symptom. It is almost always present in early life, much less common at advanced ages. The temperature may be considerably raised, even when the glandular enlargement is slight; the elevation varies from two to six degrees, and may be continuous, or with daily remissions, or periods of considerable elevation may alternate with periods in which it is only slightly raised.

COMPLICATIONS.—The pressure-effects of the enlarged glands, already mentioned, are sometimes so considerable as to give rise to complications, such as thrombosis in vessels, pleural and pericardial effusions, and bronzing of the skin from disease of the solar plexus. Intercurrent affections occasionally met with are Bright's disease, pneumonia, fatty degeneration of the heart and liver, erysipelas, pemphigus, boils, and other effects.

COURSE AND DURATION.—Lymphadenoma may remain local for a long time, even years, affecting one group of glands only, and subsequently slowly becoming general. When the general enlargement of glands is established, the disease rarely lasts more than two years. It usually terminates fatally by asthenia; but not rarely by some secondary effect of the morbid process, as asphyxia, starvation, or diarrhœa; or by a complication, especially by pneumonia.

PATHOLOGY.—The changes in the glands in lymphadenoma resemble, in the early stage, those which result from simple irritation;

and, as has been seen, the first enlargement often appears to be excited by local irritation. Clinically, however, the disease has a semi-malignant aspect. Dr. Wilks therefore assigned to it a position between cancer and tubercle. Its history suggests that it is due to both constitutional and local causes, and that the extent of these two elements varies in different cases. The constitutional predisposition apparently affects chiefly the lymphatic structures. The assumption of such a predisposition is necessary to explain the general affection of the glands which characterises some cases in the beginning, and also the persistence of the affection when it begins locally, as well as its subsequent extension. In the latter case, however, a process of secondary infection may be at work, the lymphatic tissues, already predisposed, becoming affected by the circulation in the blood of a *materies morbi* derived from the structures first diseased. The existence of an excess of white corpuscles in the blood does not present valid ground for separating certain cases from the rest, and calling them 'lymphatic leucocythæmia.' Most of such cases are, as has been said, forms of mixed disease. In simple lymphadenosis the Malpighian follicles of the spleen are diseased; and when there is a considerable excess of leucocytes in the blood, the splenic pulp is usually also increased in quantity. The anatomical lesions of splenic leucocythæmia and lymphadenosis are conjoined, and to the increase in the pulp the leucocytal excess is due. Occasionally, however, when the diseased glands are soft, lymphoid corpuscles, changed in character, pass from them into the blood, and persist there, leading to an excess of the pale cells. When the glands are hard, the production of lymphoid cells, and their passage into the blood, seem interfered with, and thus simple anæmia results.

Diagnosis.—Local glandular growths cannot be sharply separated from cases of generalised lymphadenoma, although they may be clinically distinguished. Generalisation may ultimately occur, even though one group of glands has alone been diseased for many years. In splenic leucocythæmia the glands are only affected late in the disease, after considerable enlargement of the spleen has existed alone for a long time When the spleen presents great enlargement, and the glands are affected early, the case is usually of the mixed form above described, both splenic pulp and follicles being diseased. In strumous enlargement of the glands, the disease is commonly confined to a single group of glands which have been subjected to local irritation; some of the glands often soften and suppurate; the affection occurs chiefly in early life; and other constitutional signs of tubercular cachexia may be present. Cancer of the glands differs widely in its microscopical characters from lymphadenoma, but clinically the distinction from a local lymphoma may be difficult, and turns chiefly on the slow extension of cancer to neighbouring glands, and its subsequent localisation in organs rather than in lymphatic structures.

Prognosis. — When lymphadenoma is widely spread, or the local growths are considerable in size, a fatal termination is almost certain. The duration, however, in each case, varies much. The younger the patient and the better the preceding health, the longer is the duration of the disease. The consistence of the glands has little prognostic value. The softer they are, the more rapid is the course of the disease; but, on the other hand, if it is influenced by remedial agents, the soft glands can be restored to a better functional condition than the hard. The prognosis is worse the more profound the anæmia. Elevation of temperature as a rule indicates a rapid course, but to this there are some striking exceptions, as in one case under the writer's (W. R. G.) care, in which the glandular enlargement continued slight, although the temperature for twelve months was always above the normal.

Treatment.—The possibly infecting influence of the primary glandular enlargements has led to their extirpation. Where other glands have been involved, or the spleen has been enlarged, the operation has done no good; and, in such cases, surgical interference is only justified by impending death from the local pressure. But where the affection has been confined to one group of glands, the progress of the disease has been retarded by their removal, and in some cases the malady has even been cured. The degree of anæmia is of great importance as influencing the prospect of benefit, and even of survival from the operation, and the actual proportion of corpuscles should, in all cases, be estimated by the hæmacytometer. An operation should never be performed if the proportion of red corpuscles is less than 60 per cent. of the normal. A slight excess of white corpuscles does not militate against the success of an operation. Other methods of local treatment have been employed, with some benefit, especially rubbing and shampooing, the alternate application of heat and cold, compression, and blistering. Galvano-puncture is useless. Various substances have been injected into the glands—iodine, nitrate of silver, carbolic acid, arsenic. The last has alone appeared useful (Winiwarter), but it was, in all cases, given internally at the same time. Of internal remedies arsenic is incomparably the most potent. It should be pushed to the largest doses the patient can bear, such as ♏xv. of liquor arsenicalis three times daily. It often causes some pain in the glands, followed by their diminution in size, and even, in a few recorded cases, by their complete disappearance. Although such a favourable result has not come under the writer's personal observation, he (W. R. G.) has seen a marked diminution obtained in the size of glands which were before steadily enlarging, a diminution which has been maintained for years. Phosphorus has been given in the disease (first by Verneuil), but it is far less useful than arsenic. Iodine and iodide of potassium are of little service. Cod-liver oil is useful when there is any evidence of a scrofulous diathesis. Mercury and carbolic acid have been given internally without success. Iron, useless alone, has sometimes appeared to do good when given in conjunction with other remedies. Change of air, general tonics, and careful diet are often of considerable service, especially when employed along with other measures.

W. R. Gowers. Frederick Taylor.

LYMPHANGEITIS (νύμφη, water, or lymph; and ἀγγεῖον, a vessel).—Inflammation of lymphatic vessels. *See* Lymphatic System, Diseases of.

LYMPHANGIECTASIS (*lympha*, lymph; and *angiectasis*, vascular dilatation). Lymphatic varix, or varicose dilatation of lymphatic vessels. *See* Lymphatic System, Diseases of.

LYMPHATIC SYSTEM, Diseases of.—Synon.: Diseases of the Absorbent System; Fr. *Maladies du Système Lymphatique*; Ger. *Krankheiten des Lymphsystems.*

There is no essential difference between the lymphatic and lacteal systems, which together constitute the absorbent system. The present article deals with those diseases of the lymphatic vessels and glands which are more or less of a local nature; and what is stated with regard to the former will apply generally to the lacteals, but attention will be directed to any points connected with these vessels calling for special notice. Some of the affections involving these structures are considered in separate articles, and need, therefore, merely be mentioned here. It may be remarked that important relations exist between the absorbent system and certain diseases, namely, some of those belonging to the zymotic class, and those depending upon septic conditions, such as plague, typhus and typhoid fever, diphtheria, scarlatina, rubeola, dengue, erysipelas, glanders, malignant pustule, snake-bite, dissection or *post-mortem* wounds, and certain forms of serous inflammation, such as puerperal peritonitis. The lymphatics of the pleura and lung are in rare instances the seat of suppuration. Moreover, the lymphatic vessels seem to be materially involved in some skin-diseases, such as erythema and elephantiasis; while there are certain structures in the body which consist mainly of lymphatic follicles, and their diseases principally affect these follicles. The absorbent system is also concerned in disseminating such diseases as cancer, syphilis, or tubercle through the system. These points are more fully dwelt upon in their appropriate articles, and now the individual diseases of the lymphatic system will be severally discussed.

1. Acute Inflammation. — According to the structures involved, acute inflammation, connected with the lymphatic system, presents three varieties, namely: (*a*) where the vessels are alone affected—*lymphangeitis* or *angeioleucitis*; (*b*) where the condition is limited to the glands—*adenitis*; or (*c*) where both vessels and glands are involved. It will be convenient to consider these varieties together. As a rule the disease is localised, but under certain circumstances the lymphatic system is more or less widely implicated, especially if the inflammation is of a septic character. It may be set up and extend with great rapidity.

Ætiology and Pathology.—The causes of acute inflammation of the lymphatic vessels or glands may be thus indicated: 1. *Traumatic*, including such injuries as wounds, contusions, or a severe strain. 2. *Irritation from without.* Strong heat, as that of the sun, may set up inflammation of the superficial lymphatics. Pressure or friction may also produce this effect upon the vessels or glands. It is not an uncommon practice to excite inflammation artificially in the glands, for the cure of certain of their diseases, by injecting irritants into their substance. 3. *Irritation from within.* This may be due to inflammation in the vicinity, suppuration, ulceration, diseases of joints or bones, and other causes. In medical practice the implication of the glands under the jaw, in cases of diphtheria and scarlatina, is a familiar illustration of this class of cases; or the inflammation of the glands behind the ear in cases of impetigo of the head. The lymphatic vessels are also more or less involved in phlegmasia dolens. 4. *Specific irritations.* These deserve separate recognition, and include syphilis, gonorrhœa, and various septic poisons, which frequently affect the lymphatic structures. Inflammation of the absorbent glands is also an important feature in plague, glanders, and certain other specific diseases.

With regard to the modes in which the inflammation is set up, this may happen in several ways. In the first place, the cause may act directly upon the lymphatic vessels or glands, as in the case of injury. Secondly, these structures may be involved by extension from neighbouring parts. Glands are frequently affected in this way; and lymphatic vessels may be involved by continuous extension of irritation from inflamed organs, serous membranes, or other structures with which they are connected. Thirdly, the cause of the inflammation is often more or less remote from the situation in which it appears, especially in the case of the glands. This may arise from the inflammatory change passing continuously along the vessels from some seat of irritation to the glands in their course; or morbid products may be carried by the current of lymph to the glands, the vessels themselves being unaffected, when the inflammation thus set up is said to be *sympathetic*. In other instances pus has been found within the lymphatic vessels, having made its way from some seat of suppuration. It should also be mentioned that lymphatic inflammation can originate a similar condition in other structures, such as the joints, and this may be of a purulent character.

Inflammation is much more readily excited in the lymphatic structures in some persons than in others, and especially in those who are strumous or tubercular. The glands are more liable to be affected in the early periods of life. A low state of the general health may predispose to inflammation of these structures from slight causes. Glands which are chronically inflamed are very liable to become the seat of acute inflammation from slight causes.

Anatomical Characters.—Inflammation affecting the lymphatic vessels presents two forms, but they may be met with together. When the minute capillary network is involved, the condition is termed *reticular lymphangeitis*; the skin and its capillaries are generally affected at the same time, so that there is more or less diffused redness, but it may present a reticulated arrangement. *Tubular lymphangeitis* signifies that the main vessels are implicated. They are visible on the surface as red lines, straight or wavy, passing to the glands. They become dilated, and their walls thickened. Their internal coat is opaque and uneven, and the endothelium often disappears. Coagulation of the lymph within the vessels takes place, closing up their channel. The coagulum may become organised, so that they are permanently obliterated; or it may soften and even suppurate at the centre, and the products may enter into the general circulation, thus causing septicæmia or pyæmia. The inflammation is liable to extend to the surrounding cellular tissue, leading to exudation, hyperplasia of cells, and consequent swelling and thickening.

Inflammation of lymphatic glands is characterised in the early stage by swelling, congestion, and increased firmness. The lymph accumulates, exudation takes place, and abundant cells are present. The inflammatory process may soon subside, terminating in resolution. In many cases, however, suppuration ensues, especially in certain forms of inflammation, this change commencing in the centre of the glands, the cavities of which become more or less speedily filled with pus. The inflammation spreads to the surrounding cellular tissue, and, an abscess being formed, the pus makes its way to the surface. If the glands are situated within the body, they may burst internally, or irritate adjacent structures, and thus lead to serious consequences. Sometimes the glands remain permanently enlarged and indurated, especially after repeated attacks of inflammation; and they may become adherent to the parts around. A single lymphatic gland may be inflamed, but it is common for a cluster or chain of these structures to be involved. In some cases the inflammation assumes a more or less sub-acute character, and the progress of events is slower.

Symptoms.—These are *local* and *general*. The *local* phenomena consist of subjective sensations, and objective signs. Pain is felt at the seat of inflammation, which may be very severe, often accompanied with a sense of heat or burning, and stiffness or tension. There is usually marked tenderness, and this may be present when little or no spontaneous pain is complained of, while it is often remarkably limited to the line of an affected lymphatic vessel. Movement also increases the pain. The subjective sensations are more severe as a rule when the glands are involved. When suppuration takes place, the pain tends to assume a shooting and throbbing character. As regards objective signs, inflamed lymphatic vessels, if superficial, are usually visible as red lines, either straight or wavy, running in the direction of the glands; or there may be separate red patches. Should they be deeply situated, however, the vessels cannot be seen. The larger trunks may be felt by the fingers, being cord-like, firm, and knotted. The surrounding tissues are seen and felt to be more or less swollen and indurated. If the circulation of the lymph is much interfered with, a limb may be considerably enlarged, and presents a feeling of firmness and solidity, owing to the occurrence of lymphatic œdema.

When superficial lymphatic glands become inflamed, their enlargement can be made out on examination, and the surrounding tissues may also be swollen. At first they feel firm, but if suppuration takes place they become more and more soft, and at last present a sensation of fluctuation. The overlying skin is markedly red, and there is often subcutaneous œdema. Suppurative inflammation of lymphatic glands constitutes the condition known as 'bubo.' If not opened artificially, the abscess ultimately bursts externally, but it may burrow considerably before doing so, and the opening is often imperfect. *See* Bubo.

The *general* symptoms accompanying inflammation of the lymphatic structures vary in their intensity in different cases, according to its severity, extent, and results. In the slighter cases there is no obvious constitutional disturbance. As a rule, however, more or less fever, with its accompanying symptoms, sets in, preceded often by shivering or even distinct rigors. If suppuration occurs, the rigors may be repeated; the pyrexia increases; and more or less wasting and weakness follow, should there be prolonged discharge of pus. Where the inflammation is of a septic character from the first, or when septic matters are conveyed into the circulation, the general symptoms are indicative of septicæmia, such as repeated rigors, high and erratic fever, great weakness and prostration, low nervous symptoms, weak and rapid cardiac action and pulse, and other typhoid phenomena. The termination is then usually fatal.

Treatment.—In the management of any acute inflammation affecting the lymphatic vessels or glands, the first indication is to get rid of its cause, if this be practicable. In the next place rest is of essential importance, and the affected part should be so placed as to avoid all pressure or tension. As regards *local* treatment, the application of heat and moisture, by means of fomentations and poultices, usually answers best. To these anodynes may be added, if necessary, especially belladonna; and the latter may be often applied with advantage in the form of extract, mixed with glycerine. It is not uncommonly advisable to take away blood locally from the neighbourhood of inflamed glands, by means of leeches. Some authorities maintain that suppuration may sometimes be prevented by counter-irritation around the glands, effected by applying blistering-fluid or strong iodine. If suppuration take place, the progress of the pus towards the surface must be encouraged by the usual means, and the abscess opened as soon as practicable. Should *general* treatment be required, at first it is usually necessary to keep the patient on low diet, to open the bowels well, and perhaps to administer some simple saline mixture. When suppuration occurs, a more or less supporting tonic and stimulant treatment is called for. Septicæmia demands the free use of alcoholic stimulants, the administration of full doses of quinine, and other appropriate remedies.

2. **Chronic Inflammation.**—Only the lymphatic glands can be said to be liable to this affection—*chronic adenitis*. They may remain in a condition of chronic inflammation after one or more acute or sub-acute attacks; or this is set up as a chronic affection from some continued or repeated irritation. Formerly a low form of chronic inflammation was regarded as the primary lesion in scrofulous or tubercular glands, and some pathologists still hold this view. The affected glands are enlarged and firm, and often somewhat painful and tender. These changes may be due partly to a hyperplasia of the gland-structures, partly to an exudation into their midst. Frequently they continue in this condition for a long time, without undergoing any obvious change, but they are liable to acute exacerbations from slight causes. They may ultimately become the seat of caseous degeneration, or of suppuration. The circulation of the lymph through the involved glands is prevented to a greater or less degree. Usually there is no constitutional disturbance, unless a considerable number of glands are implicated, or they undergo degeneration or suppuration.

Treatment.—It is not desirable to allow chronic adenitis to continue, as unpleasant or even serious consequences may ensue, and therefore the affected glands should be subjected to proper treatment without delay. Any source of irritation must be removed at the outset. Gentle friction over the enlarged glands, with some simple oleaginous or greasy material, may be effectual in reducing them, or it may be necessary to rub in weak iodine or iodide of potassium ointment, or to paint the surface with tincture of iodine. Counter-irritation by blisters may be sometimes useful. Internally cod-liver oil and quinine are frequently of much value; preparations of iron are also often very serviceable, especially the syrup of the iodide and phosphate. If the affected glands do not yield to treatment, it may become a question whether they should not be removed by operation.

3. **Scrofulous Disease.**—By this term it has been customary to designate a chronic disease of the absorbent glands, characterised by enlargement, followed by degeneration and caseation of the tissues and morbid products, and ending in unhealthy suppuration. It will be convenient to discuss briefly the condition under this heading, as the cases in which it occurs are definite enough, although there is a difference of opinion as to the nature of the primary lesion. By many it is regarded as essentially *tubercular*, and as a manifestation of the tubercular or scrofulous diathesis, but others regard it as a low form of inflammation.

Ætiology.—Scrofulous disease of the glands often occurs in those who are obviously of a strumous or tubercular habit, or who are hereditarily predisposed; but this is by no means always the case, for the subjects of the glandular affection may be apparently strong and healthy. Children and young persons are by far most frequently affected. The change is often originally set up by some local irritation, but in many instances there is no such obvious cause, and it appears to commence spontaneously. Once an absorbent gland becomes the seat of scrofulous lesions, others in connexion with it, or even at a distance, are very liable to become secondarily implicated.

Anatomical Characters.—Scrofulous disease may involve the lacteal as well as the lymphatic glands, and of the latter those within the body may be affected, as well as those which are external. Of the external glands, those in the neck and under the jaw are most commonly first involved. The changes always go through a more or less chronic course. At first the glands become enlarged and firm, and the enlargement has been attributed to inflammatory products, hyperplasia of the lymphatic elements, or tubercle; and tubercle-bacilli have been found. Subsequently as a rule caseation takes place, the substance of the glands becoming yellow and softened; then a slow process of unhealthy suppuration generally ensues, leading to the formation of chronic abscesses. The skin over them presents a congested appearance, and is often undermined for some distance, the subcutaneous tissues being involved in the suppurative process. If the abscesses are not properly treated, they are liable to cause much destruction of the skin, and to leave unhealthy sinuses and ulcers when they burst of their own accord. If they subsequently heal, this is often attended by extensive scarring, and the scars are permanent, but become less marked in course of time. In some cases the glands do not suppurate, but after caseation they become calcified and inert; it appears probable that this result may take place even after the formation of pus, which then becomes inspissated, and mixed up with calcareous matter.

Symptoms.—In the case of the external glands, with which we are now concerned, the changes above described can be observed clinically. They are attended with little or no pain, but there is usually more or less tenderness. Constitutional symptoms are as a rule prominent, when the glands become involved to any considerable extent, as evidenced by wasting, anæmia, general weakness, and more or less pyrexia, which, if there should be abundant suppuration, is apt to assume a hectic type. If the glandular mischief is limited, however, the system may suffer but little or not at all; and even after it has been extensive and severe, so as to lower the patient very much, recovery may take place under appropriate treatment, the patient ultimately becoming strong and robust. When the internal glands are affected, they may give rise to symptoms from their mere mechanical presence, such as those indicative of pressure or irritation; and if destructive changes occur in them, very serious results are liable to be produced. The general symptoms are also usually more marked in these cases, and may become extreme in degree. It is highly probable that phthisis may be set up by an infective process, in connexion with suppurating or caseous scrofulous glands. *See* Bronchial Glands, Diseases of; and Mesenteric Glands, Diseases of.

Treatment. — *General* treatment is of essential importance in the treatment of scrofulous glands. The patient should be placed under the most satisfactory sanitary conditions that can be obtained; but in many cases this is a very difficult matter, and it is of great importance, if possible, to remove from their unhealthy and often wretched homes those suffering from this affection, and to treat them in suitable sanatoriums or hospitals. They should be as much as possible in the open air, and a change of climate and surroundings will often prove of decided benefit. Residence at the seaside, with sea-bathing, is also of essential service, or a sea-voyage may be desirable. Margate is deservedly in great repute as a seaside resort for cases of scrofulous glands. The digestive functions require careful attention and regulation; and the food must be nutritious, including abundance of good milk, fresh eggs, and such articles of diet. As regards medicines, those which are usually indicated are cod-liver oil, quinine, and preparations of iron, especially the syrup of the iodide, steel-wine, or Parrish's syrup. In certain cases marked benefit has been found to result from the administration of minute doses of sulphide of calcium, and from chloride of calcium.

Local treatment is usually called for. In the early stages attempts may be made to cause absorption of the enlarged glands, but these must be cautiously conducted. Gentle friction, the application of preparations containing iodine or certain iodides, and the use of poultices or fomentations of sea-weeds, are the measures usually adopted. In some cases it certainly seems the best plan of treatment to try to encourage suppuration in glands which are in a torpid state, and which cannot be absorbed. For this purpose they have been injected with irritants. Suppuration and its consequences must be treated on ordinary principles; but it should be remarked that abscesses should not be allowed to burst of their own accord, but need surgical interference, as otherwise they may lead to much destruction of the skin and subcutaneous tissues. In suitable cases the best treatment consists in clearing out caseous materials, or removing masses of glands by surgical methods. Injection of tuberculin has been tried, but, to say the least, with doubtful results.

4. Hypertrophy and Atrophy of Glands. — The lymphatic glands become *hypertrophied* under different circumstances. In some cases there is a mere local hypertrophy, which shows no tendency to progress towards other parts, and which may be due to some obvious irritation, or is independent of any known cause. This morbid change is most important, however, in the disease termed *lymphadenoma*, *lymphoma*, or *Hodgkin's disease*, in which there is a progressive enlargement of the lymphatic glands; and in one form of *leucocythæmia*. These affections are discussed in separate articles. Without entering upon any description, therefore, it will suffice to remark that in these affections the enlargement varies much in degree and extent in different cases; and that the glands usually show no tendency towards any degenerative or destructive change. Clinically they are recognised by their obvious physical characters when superficial; or by physical signs when situated in internal cavities. As a rule they are painless; but may give rise to various symptoms by causing mechanical pressure, irritation, or destructive effects. In many cases more or less severe general symptoms are present. *See* LEUCOCYTHÆMIA; and LYMPHADENOMA.

Atrophy of lymphatic glands may occur from various causes, as after inflammation; as a senile change; or after the removal of a limb, or its long-continued want of use. No definite effects can be referred to this condition, but if there should be extensive glandular atrophy, it might obviously interfere with the due nutrition of the blood and general system.

5. Morbid Formations and Deposits in Glands.—Under this heading the following may be considered:—

(*a*) *Cancer* and *Sarcoma*.—The various forms of malignant growth frequently involve lymphatic glands. In most cases the disease is secondary to cancer in some neighbouring part, and the glands are very prone to become involved, owing to the direct communication through the lymphatics. This is well exemplified by the implication of the axillary glands when the breast is the seat of cancer. Not uncommonly, however, the formation in the glands is primary, and then involves other structures secondarily by direct extension or convection. All forms of cancer are met with, but the encephaloid variety is most common. When secondary, however, it generally approximates in characters to the primary formation, and hence may be of a scirrhous or melanotic type. Secondary sarcoma occurs in the lymphatic glands; and there is also a primary disease named *multiple* or *lympho-sarcoma*, which particularly affects the mediastinal glands. A malignant glandular tumour may attain a considerable size, and it is more or less nodulated. The consistence will depend on the variety of the growth; often it is soft, and a milky juice escapes on pressure. If cancerous glands are external, they can be recognised on examination, and are usually painful and tender. When situated internally they give rise to physical signs of their presence, either in the chest or the abdomen, and to more or less pressure-symptoms, which may be combined with the constitutional symptoms of malignant disease. It may be very difficult to distinguish clinically between cancerous glands and lymphadenomatous growths situated internally.

(*b*) *Albuminoid disease*.—The absorbent glands are liable to be involved in conditions which give rise to albuminoid degeneration. On section they present the peculiar waxy, pale, translucent, homogeneous appearance characteristic of tissues which are the seat of this change. The glands may be enlarged; but when they attain a considerable size, this is partly due to hypertrophy. In other cases they are small and firm. This condition may give rise to symptoms by pressure, as sometimes happens in the case of albuminoid glands in the portal fissure, which may cause ascites or jaundice.

(*c*) *Pigmentation*.—The bronchial glands are usually the seat of a deposit of black particles, in cases where the lungs are similarly affected, as in miners, colliers, &c. They are enlarged to some extent, and black; and a black liquid escapes on pressure. This condition does not give rise to any obvious symptoms. More or less pigmentation of these glands is often observed with advancing age.

(*d*) *Syphilitic disease*.—The glands in the groin are affected from the irritation of the primary syphilitic sore, and others are often involved in connexion with its secondary and tertiary manifestations. Syphilitic glands are of moderate size, indurated, indolent, painless, and freely movable.

(*e*) *Tubercle*.—In addition to what has been stated under SCROFULA, it must be mentioned that distinct grey granulations are sometimes found in connexion with the glands in acute tuberculosis. A class of cases of progressive diffused tuberculous disease of the lymphatic glands has also been described, occurring in adults, in which nearly all the glands in the body are simultaneously, or in rapid succession, affected with tubercle, leading to suppuration. They are attended with fever and rapid wasting, and end fatally in from six months to a year. (*Principles and Practice of Medicine:* Fagge and Pye-Smith.)

TREATMENT.—Practically the treatment of the morbid formations in glands just considered, if any be called for, consists in measures directed against the constitutional condition of which they are a manifestation. Operative interference may be demanded in suitable cases. Symptoms, especially those resulting from pressure, may also require special treatment.

6. Chronic Changes affecting Lymphatics.—The lymphatic vessels are subject to two principal classes of chronic changes, namely: (*a*) *Dilatation* and *hypertrophy*; and (*b*) *Obstruction.*

(*a*) *Dilatation* and *Hypertrophy—Lymphangiectasis.*—Leaving out of consideration the thoracic duct and receptaculum chyli, the lymphatics, either superficial or deep, and also the lacteals, may become more or less dilated and hypertrophied. Even the vessels of internal mucous or serous membranes may be thus affected. In most cases the larger trunks are implicated, but the capillary plexuses are sometimes chiefly or alone involved. With regard to the causes of this condition, it is often congenital, and has then been attributed to a want of specialisation in the lymphatic system of certain parts. In other cases it is evidently due to some obstruction to the circulation of the lymph, and consequent enlargement of the vessels behind the impediment. Such obstruction may be seated in the glands or vessels, and in the latter case may be due to internal plugging or to external pressure. In some instances the enlargement of the lymphatics partakes of the character of a primary hypertrophy, either alone or along with other tissues, as is the case in connexion with elephantiasis and certain other growths, of which enlarged lymphatics constitute an important element. Dilatation has been also attributed to a supposed paralysis of the muscular coat of the lymphatic vessels. Lymphangiectasis is most common in warm and moist climates.

There are various forms which enlarged lymphatics assume. Thus, there may be simply a localised dilatation of the capillaries, constituting a visible freely anastomosing reticulum or network. More commonly the trunks are enlarged, assuming a tubular, fusiform, varicose, saccular, or cirsoid form. Or a distinct growth may be produced, which has been specially termed *lymphangiectasis*, and has been divided by Wagner into three varieties—(i) *simple*; (ii) *cavernous*; (iii) *cystoid*—names which sufficiently indicate their several peculiarities. The walls of the vessels are often more or less thickened from hypertrophy. Dilated lymphatics are liable ultimately to give way, with consequent escape of the lymph.

Clinically, the conditions now under consideration are visible when superficial, or when occurring on a surface which can be inspected. The appearances will differ according to the particular morbid change present. There may be a distinct tumour; or the enlarged lymphatics may only form one element in certain growths. Cystic formations originating in the lymphatic system are said to be most common in connexion with the upper lip, tongue, and neck. Enlargement of the superficial lymphatics is chiefly observed on the inner side of the thigh, the sides of the abdomen, and the scrotum and penis; they appear in the form of vesicles like grains of sago, grouped regularly or irregularly. Sometimes only ampullæ are formed, which are generally soft and painless. These conditions have been mistaken for hernia, abscess, scrofulous glands, and other diseases. Should the dilated lymphatics rupture subcutaneously, vesicles containing a clear or milky fluid appear. They may rupture on the surface of the skin, the lymph being discharged externally, which is an important point in the diagnosis of doubtful cases. When dilated absorbents are situated internally, they cannot be recognised unless they should happen to rupture, with the escape of their contents by some outlet. This applies mainly to the lacteals, the contents of which may pass out with the stools, and to the urinary mucous membrane, it being supposed by some pathologists that the condition termed *chyluria* is merely due to the rupture of dilated lymphatic vessels in this membrane. *See* Chyluria.

(*b*) *Obstruction.*—As in the case of dilatation, the capillary plexuses or larger lymphatics may be obstructed. This may arise chiefly from plugging of their channels by coagulated lymph; inflammation of the vessels; pressure by enlarged glands, aneurysms, or other tumours, or merely as a result of inflammation of the cellular tissue around the vessels. It may be remarked here that lymphatic tissues, similar to those observed in the glands, sometimes form here and there in the course of the lymphatics in cases of lymphadenoma. The lymphatics of the urinary mucous membrane are also supposed by some pathologists to be blocked by *filariæ*, and they consider that this is the cause of chyluria. *See* Filaria Sanguinis Hominis.

The effects liable to be produced by obstruction of lymphatic vessels are swelling, from so-called lymphatic œdema; and dilatation of the vessels behind the obstruction, which may lead to their rupture. It is by these effects alone that this condition can be recognised clinically.

Treatment.—But little can be done for the chronic changes affecting lymphatic vessels now under consideration. Proper bandaging, or the use of some elastic support, may be of use in treating dilated vessels, if they happen to be conveniently situated. Friction and kneading may assist in removing lymphatic œdema due to obstruction. Growths come under the treatment of the surgeon, and do not call for any special remark here.

Frederick T. Roberts.

LYMPHATIC TEMPERAMENT. *See* Temperament.

LYMPHOMA.—A synonym for lymphadenoma. *See* Lymphadenoma.

LYMPHORRHAGIA or **LYMPHORRHŒA** (*lympha*, lymph, from *νύμφη*. water; and *ῥήγνυμι*, I burst forth, or *ῥέω*, I flow).

Definition.—These terms literally signify a flow of lymph, but they are used to indicate an abnormal discharge from any part of the absorbent system, whether it be of lymph or of chyle.

Ætiology and Pathology.—Lymphorrhagia may take place from the lymphatic capillaries or trunks; from the lacteals; from the absorbent glands; or from the receptaculum chyli or thoracic duct. Cases in which this condition occurs are usually divided into *traumatic* and *idiopathic*, according to their apparent causation. In the former the cause is a wound, which generally affects either the thoracic duct, the larger lymphatic trunks, or the glands. A discharge of lymph has in rare instances followed even a slight wound, particularly in the neighbourhood of joints, and this was attributed by the late Mr. Messenger Bradley to a constitutional defect—a *lymphorrhagic diathesis*, corresponding to the hæmorrhagic diathesis. *Idiopathic* lymphorrhœa is almost always the result of dilatation of one or more vessels, which ultimately rupture. They are often greatly distended before they give way. Allusion may be made here to the supposed relation of chyluria to the presence of *filariæ* in the lymphatic vessels of the urinary organs, these parasites causing them to rupture, and the lymph consequently being discharged with the urine. *See* Filaria Sanguinis Hominis.

Symptoms and Effects.—Should an escape of lymph take place upon any part of the surface of the body, it differs much in its quantity and characters in different cases. It may be less than an ounce, or amount to five and even ten pounds within the twenty-four hours; while in the same case its quantity is liable to variation from time to time, and the flow has even been known to assume a periodic character, increasing during the period of digestion. In traumatic cases the discharge either presents the ordinary appearance of lymph, being clear and limpid, or it is mixed more or less with blood or with inflammatory products. When rupture takes place spontaneously after dilatation of the vessels, the fluid is more like chyle, being more or less milky and white, from the presence of particles of fat, but its characters are liable to alter from time to time. It contains a variable quantity of fibrinogenous elements, and is proportionately disposed to coagulate spontaneously. Internal lymphorrhagia causes different results. In the case of the intestines and urinary organs, the fluid is discharged with the fæces and urine respectively, in the former case being supposed to give rise to fatty stools, and in the latter to chyluria. The late Mr. Bradley attributed some cases of effusion into serous cavities, such as certain forms of hydrocele, hydrocephalus, pleuritic effusion, and ascites, to a lymphorrhagia into the respective cavities; and the writer has met with a case of ascites which seemed to support this view. Fatal peritonitis has resulted from the entrance of chyle into the peritoneum, owing to the rupture of a dilated receptaculum chyli. The escape of lymph or chyle out of the system tends to affect the general health, and, if it is in large amount, this is likely to lead to marked emaciation, debility, and anæmia.

Treatment.—In external lymphorrhagia all that can be done is to check the flow of lymph by pressure of bandages, and the application of astringents. In cases where it takes place into internal passages, tincture of perchloride of iron in full doses may be of service. The general condition must be attended to, and improved by nutrients and tonics, if required.

Frederick T. Roberts.

LYPEMANIA (λύπη, grief; and *μανία*, madness).—The name applied by Esquirol to the form of insanity characterised by mental depression, usually called melancholia. *See* Melancholia.

LYSIS (λύω, I dissolve).—This word had formerly various significations, but is now generally applied to the *gradual* decline of any disease or pathological process, especially fever. *See* Fever.

END OF THE FIRST VOLUME.

WELLCOME LIBRARY INSTITUTE

Spottiswoode & Co. Printers, New-street Square, London.